



WAR NEUROSES
AND SHELL SHOCK
F. W. MOTT

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WAR NEUROSES AND SHELL SHOCK

BY

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WITH PREFACE BY

THE RT. HON. CHRISTOPHER ADDISON, M.P.

MINISTER OF RECONSTRUCTION



LONDON

HENRY FROWDE

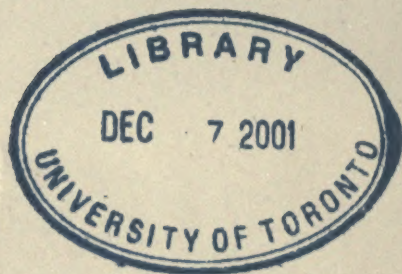
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TO
A GROUP OF
AMERICAN MEDICAL OFFICERS
WHO WORKED WITH ME AT THE MAUDSLEY HOSPITAL
THIS LITTLE BOOK IS DEDICATED
AS A FRIENDLY MARK OF APPRECIATION OF
THEIR EARNESTNESS AND EFFICIENCY
IN THE STUDY AND TREATMENT OF CASES OF WAR
NEUROSIS ADMITTED UNDER MY CARE

29998

PREFACE

BY THE RT. HON. CHRISTOPHER ADDISON, M.D., M.P.
MINISTER OF RECONSTRUCTION

My friend Brevet Lieut.-Col. F. W. Mott, F.R.S., has given me the privilege of saying a few words of introduction to his valuable book on *War Neuroses and Shell Shock*. Its importance will be obvious to all members of the medical profession, for the problems with which it deals will, unhappily, remain with us long after the end of the War. But it seems to me well to emphasise the fact that the book is above all a record of astonishing success in the treatment of disorders which at first sight, and to all laymen who encounter them as relatives or friends of the sufferers, must appear peculiarly painful, mysterious, and intractable.

Since the outbreak of War the author has devoted his whole time to the investigation and treatment of cases of War Neurosis and Shell Shock, first at the Neurological Section of the 4th London General Hospital and later at the Maudsley Neurological Clearing Hospital. He has therefore had unusual opportunities of studying the subject, and this work is based mainly upon his own experience, although foreign literature is quoted freely, especially the important work of the French Neurologists.

The book brings together the conclusions which he has derived not only from extensive clinical observations, but

also from much original anatomical research relating to the effects of Shell Shock and Gas Poisoning upon the central nervous system. A good deal of this work has been published in the Lettsomian Lectures of the Medical Society, *The Effects of High Explosives upon the Central Nervous System*, 1916, as well as in other addresses and communications to learned Societies.

It is, I believe, the only complete account yet published of the pathological changes in the nervous system in Shell Shock and Gas Poisoning. It is in these changes that an explanation must be sought of the symptoms met with in fatal cases of Shell Shock and concussion of the brain and spinal cord, so that Col. Mott's researches should be instructive and interesting to the medical profession from a practical as well as from a scientific point of view.

As Pathologist to the L.C.C. Asylum, Col. Mott was able to turn to account his pre-war studies on hereditary predisposition by pointing out early in the War the importance of the inborn-factor in the production of War Neuroses and Psychoses, and he emphasises in this work the futility of trying to make good soldiers out of poor material. A conscript army drawn from all grades of society, after a medical examination which can hardly be expected as a rule to be of a specialist standard as to fitness for general service, will in his view of necessity contain a large percentage of men with an inborn or acquired nervous predisposition, who when put to the severe nervous strain of shell fire and the stress of trench-warfare break down after a short time, either from exhaustion or from emotional shock.

Col. Mott is concerned to show that the majority of cases of so-called "Shell Shock" are truly "Emotional Shock." He illustrates his argument by comparative statistics. It has been calculated that one-seventh of all the soldiers who have been discharged from the army as

permanently unfit, or one-third of the unwounded, are cases of Shell Shock, War Neurosis or Psychosis. It would be difficult to exaggerate the gravity of this statement.

Another set of statistics upon which Col. Mott lays stress is the large number of higher-grade mental defectives discovered in the course of the medical examination of the male population of military age. As the Prime Minister has said, we have discovered that there are too many C3 men, and it will be the endeavour of all concerned with health administration to make an increase in the numbers of A1 men part of the programme of Reconstruction.

Col. Mott points out that the War Neuroses present no essential clinical differences from those met with in pre-war days. They belong to the two great groups of functional nervous diseases—hysteria and neurasthenia—the symptoms being the same, but coloured by war experiences. Numbers of illustrations are given which show that the psycho-pathology of war “consists fundamentally in the exaggeration and perseveration of instinctive defence reactions incidental to normal physiological conditions, viz. protective pain, fatigue, and the emotion of fear.”

The Psychology of Soldiers' Dreams is of great interest, for it shows how true is the statement of Lucretius: “And generally to whatever a man is closely tied down and strongly attached, on whatever subject we have previously much dwelt, the mind having been put to a more than usual strain in it during sleep we for the most part fancy we are engaged in it.”

A large number of striking photographs of patients, before and after treatment of their disabilities and deformities, illustrate the work. One statement which the author makes seems to me to be of peculiar interest as indicating that the treatment of functional motor disabilities and deformities urgently requires increased attention, with a view to the saving of health and happiness in the interests alike of the sufferers from these disorders

and of the community. It is that large numbers of cases of functional disabilities and deformities in the nature of paralysis and contractures, whether associated with wounds or not, have been cured by him in a few minutes, a few hours, a few days, or at most a few weeks, even though they had existed many months and sometimes a year.

Inasmuch as large numbers of these cases have been discharged from the Services uncured, and are receiving pensions, it follows that the subject of "War Neuroses and Shell Shock," though the War is now over, will be one of immediate national importance to the Ministry of Pensions, and to the projected Ministry of Health, and must remain so for years to come; for the longer these disabilities are allowed to persist the more difficult are they to cure. A book, therefore, which deals comprehensively with this subject cannot fail to prove of great value.

Col. Mott develops the argument that fear is a biological instinct, and emphasises the enormous importance of contemplative fear in the perseveration of hysterical paralysis, contractures, and speech defects. Now that hostilities have ceased, and the idea of return to an intolerable situation has been removed, large numbers of these cases should spontaneously recover.

Still, a large number of discharged men suffering from functional disabilities are in receipt of pensions, and Col. Mott takes the view that the receipt of a pension suggests permanence of the disability. It is, he points out, a well-established fact that the effective mode of cure of hysterical manifestations is contra-suggestion, and he concludes that every effort should be made to induce such men to take up suitable employment, and that no man should be discharged with a curable functional disability and without the prospect of employment. In the Chapter on Treatment attention is called to the value of occupation as a mental diversion, and graduated employment on the

land and in the workshop is strongly advocated as a means of promoting convalescence. The importance of establishing an atmosphere of cure in a hospital is emphasised, and music, including training in singing, is strongly recommended as a means of restoring health to mind and body.

C. ADDISON.

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The Effects of High Explosives upon the Central Nervous System

THE effects of high explosives upon the central nervous system fall into three groups—

1. Immediately fatal either from pieces of shell, stones, rocks, or portions of buildings striking the individual, causing instant death, or burial of the person in a dug-out or after the explosion of a mine. Instant death must have occurred in groups of men in trenches, dug-outs or concrete pill-boxes from the effects of shell fire, or bombs employed now so largely in offensive aerial warfare, and yet no visible injury has been found to account for it. This matter will be discussed more fully later.

2. In Group 2 we can place those cases in which the detonation of high explosives has caused wounds and injuries of the body, including the central nervous system, which have not been immediately fatal. The number of these cases which do not exhibit any of the functional disorders and disturbances characteristic of what is termed "shell shock" without visible injury, although such individuals have received most serious and fatal wounds from exploding shells, leads one to consider that in a large proportion of cases of shell shock without visible injury there are other factors at work in the production of the nervous symptoms besides the actual aerial forces generated by the explosive.

3. The third group includes affections of the central nervous system without visible external injury.

The causes of shock to the nervous system by high explosives may be considered under two headings :—

(1) *Physical trauma*—concussion or “*commotio cerebri*” by direct aërial compression followed by decompression or by the force of the aërial compression blowing the person into the air or against the side of the trench or dug-out; or by blowing down the parapet or roof on to him, causing concussion; or a sandbag hitting him on the head or spine might easily cause concussion without producing any visible injury. Again, he might be buried and partly asphyxiated or, under certain conditions, suffer from deoxygenation of his blood by CO poisoning, for, as will be shown later, these high explosives generate considerable quantities of CO, which is inodorous and would not be recognised. A man lying unconscious or even conscious and partly buried and unable to move would be very liable to be poisoned by CO and not know anything about it; nor would the rescuers, as the poisonous effects of the gas depend upon the amount in the atmosphere and the length of time to which the individual is exposed to it.

(2) *Psychic trauma*.—The psychogenic factor is by far the most frequent and important cause of shock followed by a psychoneurosis, particularly hysteria. This factor is complex in its origin, being dependent in a great measure upon the personality of the individual soldier, his mental attitude, and bodily condition at the time of the shock (whether of emotional or commotional origin) which led to his collapse.

In many cases of shell shock followed by a psychoneurosis the history shows that both physical and psychic trauma had combined to bring about the incapacity for which the soldier had been evacuated.

“Shell shock” is a useful term if it is limited to cases where there is definite evidence of a shell or bomb bursting near enough to knock the man down, or blow him up in the air and cause a temporary loss of consciousness. According to Léri a large shell bursting within ten metres will produce commotional shock. The effect is more severe if

it bursts in a closed space such as a dug-out, or narrow trench. Army Form W. 3436 now accompanies the man with a description of the occurrence. This was found to be essential, for true shell shock is very properly recognised as a "battle casualty" and entitles the patient to a gratuity. Moreover, it is very important to recognise the fact that a man who has suffered from true shell shock is not fit to return to general service for six months at least, and in many instances not at all.

A Brief Survey of the Dynamic Conditions of the Central Nervous System, Especially in Relation to the Cerebro-Spinal Fluid and Shock

The whole central nervous system is contained in a closed space, the walls of which are formed by the cranium and spinal column, inside of which is the stout dura mater. Within this closed space is the cerebro-spinal fluid, which fills up all the space not occupied by blood-vessels or tissues. The cerebro-spinal fluid thus serves to equalise the pressure throughout the whole cranio-spinal cavity; moreover, at the base of the brain, where the vital centres of the medulla are situated, it acts as a water cushion, protecting them from the shock of commotion and concussion. The cerebro-spinal fluid also serves as a self-adjusting mechanism by maintaining a uniform equalisation of the blood supply to the nerve elements during the rhythmical variations of respiration and circulation. Now this fluid is incompressible, and under ordinary conditions of pressure from without it serves as a perfect protective mechanism, but when large quantities of these high explosives are detonated an enormous aerial compression is instantly generated, and it is quite possible that this may be transmitted to the fluid about the base of the brain and cause shock to the vital centres of the floor of the fourth ventricle, causing instantaneous arrest of the functions of the cardiac

and respiratory centres. Lord Sydenham, one of the highest authorities on the dynamics of explosives, concludes that the forces generated are sufficient to cause instantaneous death, and he has informed me that in the American Medico-Military Report it is stated that "an aneroid showed that the explosion of one of these shells caused a sudden atmospheric depression of about 350 mm. of the mercury tube, corresponding to a dynamic pressure of about ten tons to the square yard." One effect of this is to liberate air suspended in the blood and transform it into bubbles of gas which are driven into the capillary vessels and cause instant death. The writer, Surgeon Fauntleroy, is not satisfied with the explanation, which "does not take into account the primary air compression by which men are sometimes hurled into the air. He (says Lord Sydenham) considers, as I do, that the blow on the body, especially over the heart and abdomen, may cause instant death. Experiments upon animals have shown that the sudden compression and decompression produces rupture of the air vesicles of the lungs and hæmorrhage. This may occur in man" (*vide* p. 38). I have had officers under my care who have been blown in the air considerable distances. One Royal Army Medical Corps officer told me he was blown thirty feet; another told me that he was blown a considerable distance in a communication trench and lost consciousness for some time; another told me that the effect was like a violent push of irresistible force with a down cushion. But I shall have occasion later to refer to this explanation of sudden death when considering the various theories regarding the cause of death of groups of men found in postures and attitudes of the last act of life. If aerial concussion by the forces generated by high explosives can cause death without visible injury, I think probably it would arise from sudden arrest of the medullary centres. The stem of the brain, surrounded by the cerebro-spinal fluid, is prevented from oscillating

by the nerves which issue from it to pass through the holes in the skull; likewise the spinal cord, by the anterior and posterior roots and the ligamentum dentatum, is prevented from oscillating. A sudden shock of great intensity would be transmitted through this incompressible fluid, and, seeing that it not merely surrounds the central nervous system but fills up the ventricles and central canal and all the interstices of the tissues, serving as it does the function of lymph, it follows that a shock communicated to the fluid of sufficient intensity would make itself felt on all the neurons. When this was written I had not the knowledge which I now possess of changes in the central nervous system as a result of shell shock, but, as the evidence (*vide* pp. 36-71) tends to support the view I took when I delivered the "Lettsomian Lectures" in February 1916 to the Medical Society, I have not deemed it advisable to alter the original text.

I have, however, from a far greater experience come to recognise the fact that the psychogenic factor is the predominant causal agent in "War Psychoneuroses," and that a large proportion of cases which were regarded as shell shock did not owe their condition to any pathological changes which would have been recognisable in the central nervous system by any known methods of microscopic investigation; in fact, they were functional psychoneuroses. The psychogenic factor and the part it plays is fully discussed on p. 130.

The Neuron Doctrine in Relation to "Shock" and the Theory of Diaschisis¹

The central nervous system consists of innumerable anatomically distinct nervous units. Each consists of a cell with branching processes; there is one process the axon,

¹ The full account of the theory of diaschisis is set forth by von Monakow of Zurich in his recent great work, *Die Lokalisation im Grosshirn, und der Abbau der Funktion durch kortikale Herde*, 1914.

the remaining processes are termed dendrons. The axon and dendrons are conductile; the chemical changes incidental to nervous action almost entirely occur in the cell and at the synapse or junction of the terminal fibrils of the

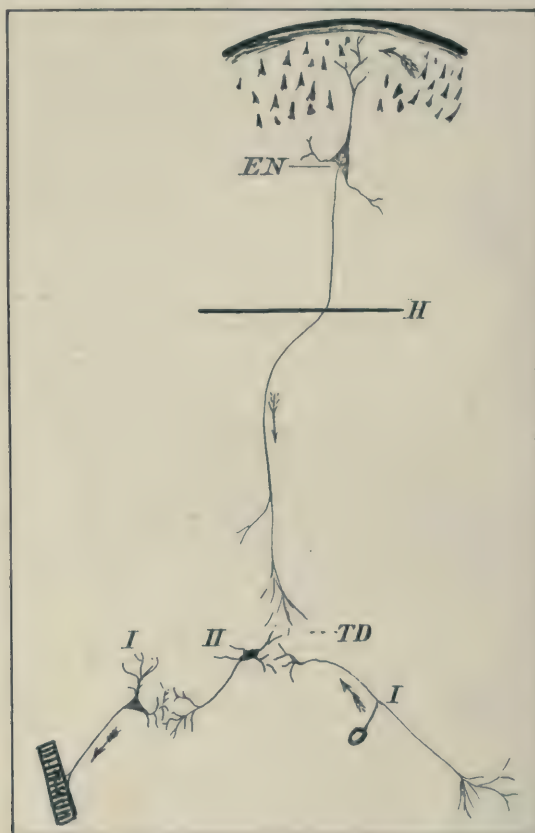


FIG. 1.—Diaschisis. EN, effector neuron of voluntary movement; H, seat of hæmorrhage in internal capsule causing shock transmitted to terminals in reflex arc of spinal cord; TD, temporary intercalary dissociation of reflex by shock.

axon of one neuron with the intercalary neurons. There are two types of neurons, the first type of Golgi, in which the axon leaves the grey matter to become surrounded by

a myelin sheath to enter into the formation of the white matter, and the second type, in which the axon never leaves the grey matter; these are the intercalary neurons (Fig. 1). They always intervene between neurons of the first type, and in the cerebral cortex they form definite layers especially well developed in the sensory projection centres, *e.g.*, of vision and hearing. I will endeavour to show how retraction of the branching processes of these intercalary cells would shut off consciousness of the external world.

The whole of the neurons of the central nervous system may be primarily divided into these two groups: (1) Neurons of the first type, which may again be divided into sensory or afferent projection, motor or efferent, and association neurons. (2) Neurons of the second type or intercalary. To take a few typical examples of the influence of shock affecting one part of the central nervous system and thence transmitted through anatomically and functionally correlated neurons to remote parts: in hæmorrhage into the internal capsule we have a sudden irruption of blood cutting through the pyramidal efferent system of fibres, resulting in a flaccid paralysis of the opposite limbs (Fig. 1); the shock effect has been transmitted to the intercalary neurons at the base of the posterior horn of the spinal cord, and for the time being it has suspended the normal reflex tonus, that is to say, dissociation of the sensory projection fibres of the reflex arc has occurred. But we know that as soon as the shock effect has passed off a spastic condition supervenes on the flaccid. The reason of this is that the normal inhibitory cortical influence has been interrupted and, association of the sensory afferent and motor efferent in the reflex arc having been restored by a return to normal function of the intercalary neurons, the reflex tonus is increased by withdrawal of the cortical inhibitory influence. Let us take another example of which I have seen several: a bullet wound of the occipital region of the skull causes complete blindness, but not

deafness. After a time the patient is left with hemianopsy; the fact that the wound did not produce deafness shows that it was not general shock to the brain that led to the opposite occipital lobe being temporarily put out of function (Fig. 2). The two occipital lobes are anatomically and functionally correlated, and the injury of one lobe caused a functional

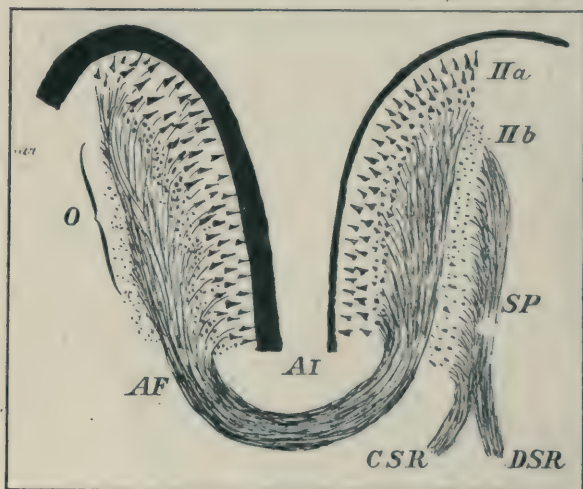


FIG. 2.—Diaschisis. O, injured occipital lobe; AF, association fibres through which shock effect is transmitted to opposite occipital lobe; AI, fibres of splenium; II, two layers of intercalary cells—(a) association, (b) sensory receptors; SP, sensory projection; CSR, crossed sensory receptor fibres; DSR, direct sensory receptor fibres.

dissociation by the shock effect having been transmitted through the association fibres of the splenium. This temporary dissociation by shock of anatomically and functionally correlated systems of neurons has been termed by von Monakow diaschisis.

The Living Neuron in Relation to Shock

The researches of Ross Harrison on the living neuron and its growth render it possible to accept as a provisional hypothesis the theory of attraction and retraction of den-

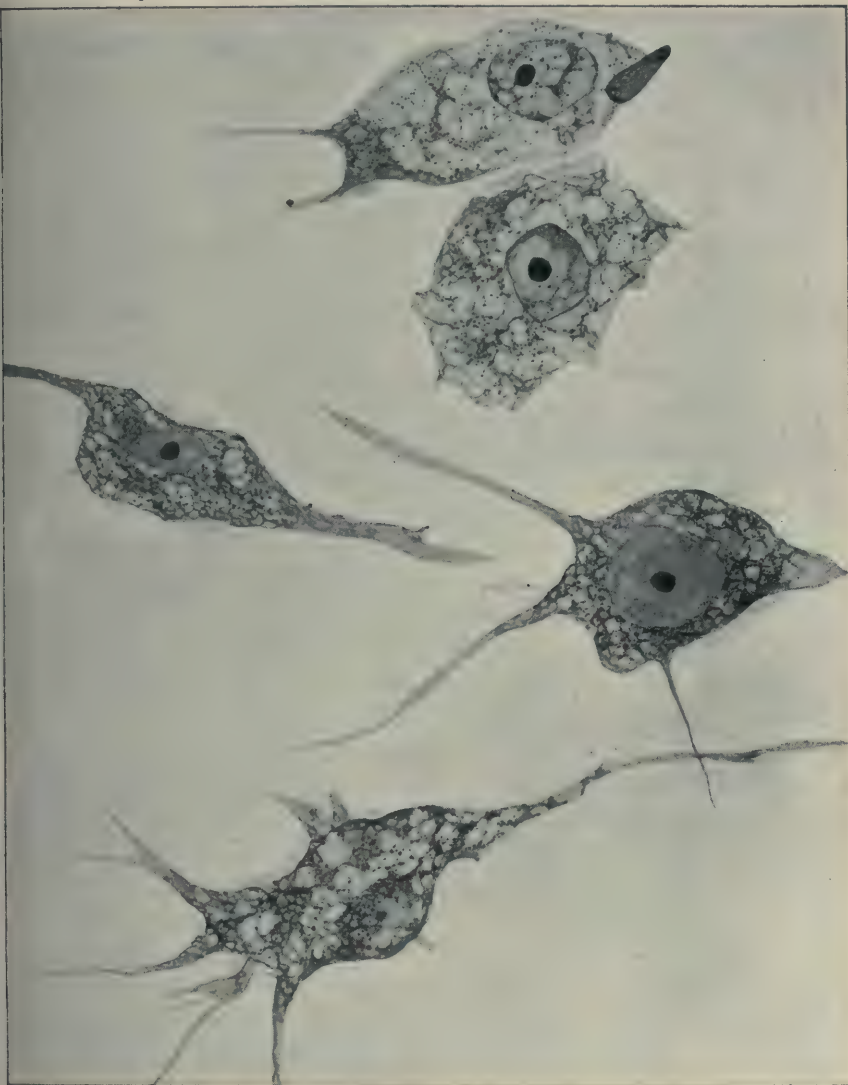


FIG. 3.—Five cells from a case of a man who lived eight hours after receiving an electric shock of 20,000 volts. A very diffuse chromatolysis with loss of basophile staining substance, thereby revealing the intracellular and intranuclear networks, is observed. Polychrome staining. (Magnification 810.)

drons as an explanation of association and dissociation. The intercalary neurons may, indeed, possess amœboid movement. A study of the living neuron shows that totally erroneous ideas may arise if we are guided by the appearances presented by the neurons in sections after they have been submitted to hardening and fixing reagents. Especially is this so in respect to the effects of shock by concussion generated by high explosives. The remarkable observations of Colonel Gordon Holmes on gunshot injuries of the spine causing concussion of the spinal cord without penetration of the dura mater by the projectile show the importance of a consideration of the living neuron. The force of the concussion produces most extraordinary changes in the axons, which become enormously swollen.

The condition of the nerve cell may be studied in sections by two methods, in one of which fibrils can be demonstrated by the silver method of Ramon y Cajal; the other by which a basophile staining substance (the Nissl granules) forms a pattern around the nucleus. The neuron, when damaged by injury or disease, shows various changes in the appearances of the cells whether the fibril method of staining be adopted or the Nissl granule method, *e.g.*, if the processes of the cell be cut, the living neuron is wounded, and the body of the cell after it has been killed by the process of fixation and hardening, exhibits changes; likewise, if the neuron has been damaged by a poison, changes are seen, but there is nothing specific about these changes, *e.g.*, one could not recognise any difference in the perinuclear chromatolysis of lead encephalitis, alcoholic psychosis, experimental anæmia and section of the axons of nerve cells. The Nissl granules of basophile substance, as I pointed out in the Croonian Lectures, 1900¹—"On the Degeneration of the Neuron"—do not exist in the living cell. Nevertheless, the amount of this basophile staining substance in the form of Nissl granules may be regarded as

¹ *The Lancet*, June 23, 1900, p. 1779.

evidence of the amount of energy substance (neuro-potential) which the cells possessed during life (Fig. 3). In the healthy cell it is continually undergoing disintegration and automatic reintegration. When the cell is damaged, metabolic equilibrium is no longer maintained, and its osmotic surface-tension is altered, and water passes into the cell causing it to swell, displacing the nucleus, and causing an appearance of chromatolysis. But this basophile staining substance which forms the Nissl granules does not exist as such in the living cells. If the living cell be

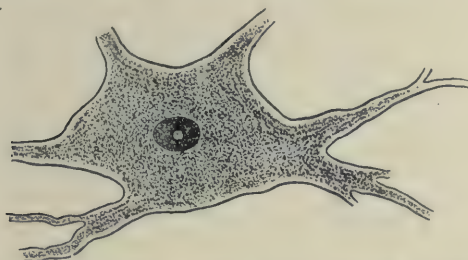


FIG. 4.—Anterior horn cell of spinal cord examined immediately after death by direct illumination. The grey matter was teased in cerebrospinal fluid and the preparation examined on a warm stage. The cell is seen to possess no Nissl bodies, but is filled with dark granules like an emulsion. (Obj. 4 mm., oc. 4.)

examined by direct illumination, no Nissl bodies are seen in the cytoplasm, only fine dark granules like an emulsion (Fig. 4). If living cells are examined microscopically with dark-ground illumination (Fig. 5), they are seen to be filled with small granules or globules, each of which after escaping from the cell remains discrete. They are refractile, and appear white and luminous; this is due to a delicate covering film of a lipid substance which encloses a colloidal fluid, probably consisting of a solution of salts and cell globulins. When the cell dies this colloidal fluid is coagulated, and the precipitated proteid substance is massed together into little blocks—the Nissl granules; the intervening denser colloidal substance is continuous

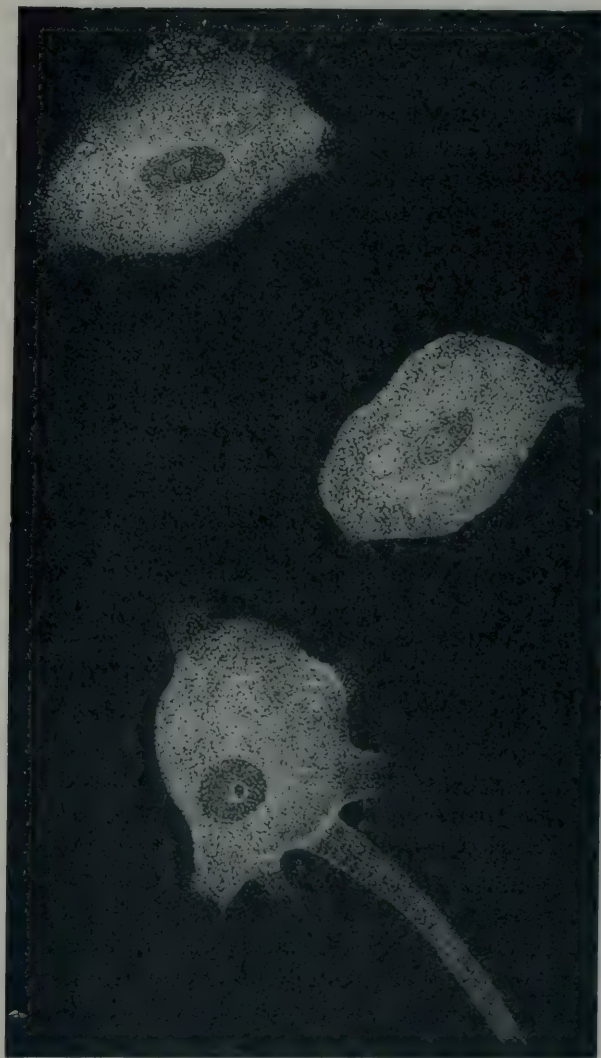


FIG. 5.—Drawing of an anterior horn cell (right hand) with processes and two posterior spinal ganglion cells as seen by dark-ground illumination while still in the living state. The cells are teased out of the tissue in warm cerebro-spinal fluid or Ringer's fluid. The microscope is placed in a warm chamber with a glass front. In this way the living cells can be observed for some time. (Obj. 4 mm., apochrom. oc. 4.)

with the colloidal substance of the axon and dendrons. The film that covers each globule is stainable by vital methylene blue, and a living nerve cell stained by vital blue presents the appearance of an emulsion of minute faintly blue globules. If the living cell thus stained be kept in an atmosphere of nitrogen in a warm chamber the stored oxygen is used up and a leuco-base is formed, causing the globules to lose their colour, and the cells appearing of a greenish tint. On admission of oxygen the living cell again becomes blue. It thus appears possible¹ that these granules represent a large oxygen surface, like spongy platinum, within the cell. When the cells die, the lipoidal film of the globulin-containing fluid is destroyed, coagulation occurs, and the Nissl granules are formed. These facts accord with the knowledge that stimulation of a piece of nerve causes practically no metabolic change or using up of oxygen, therefore the mere conduction of a stimulus along a nerve does not entail loss of neuro-potential. The chemical processes incidental to the using up of nervous energy in the neuron take place in the cell itself and at the synapses of the terminal fibrillæ, and for this reason it is that the blood supply of the grey matter is six times that of the white matter. In all active neural processes oxygen is used up and carbonic acid is produced which escapes into the circumambient cerebro-spinal fluid. One stimulus differs from another that is discharged into a cell by variation in modes of motion, and it is conceivable that the granules which fill the cell are sensible to the varying modes of motion, and an oft-repeated stimulus suffices by the establishment of a biorhythm in the cell to pass through to the intercalary neuron with little expenditure of neuro-potential, whereas a new stimulus which requires a concentration of attention must be either transformed or rein-

¹ The experiments relating to the living cell were commenced before the war, and I have not had time or opportunity to prosecute this research further; I therefore put forward this hypothesis tentatively in my Lettsomian Lectures, 1915.

forced before connection of the terminals of Neuron I with Neuron II (see Fig. 1) can take place, and this involves a using up of neuro-potential. Severe concussion can not only cause immediate dissociation of the cortical perceptor neurons, producing unconsciousness or a disturbance of consciousness, but for a varying period of time it can destroy the power of recollection of perceptions prior to the shock. There is a retrograde amnesia, and in very severe cases of shell shock, as I shall point out later, there may be a complete loss of memory both as regards recollection and recognition. The loss of recollection may be attributed to dissociation of the higher association systems of pyramidal neurons which form a sheet of cells of three layers covering the whole cortex cerebri. The loss of recognition may be attributed to a dissociation between the cortical perceptor systems of neurons, and in complete loss of consciousness of the external world there is dissociation of all the afferent projection fibres of subcortical neurons from the perceptor systems of neurons. Functional blindness and deafness, which often persist when consciousness returns, may be due to one afferent system remaining dissociated.

But why, it may be asked, do we find varying degrees of retrograde amnesia associated with loss of recollection of recent experiences, while those of earlier life may be preserved? Shock so severe, or toxic influences such as alcohol, do not cause dissociation of the neurons in which habitual actions by frequent repetition have been registered, and their revival requires a much less expenditure of neuro-potential the more they have become habitual and instinctively automatic. For the same reason the earlier experiences have been stored in memory, the more do they form the foundation upon which associative memory rests, for consciously and unconsciously these early experiences have been exerting continually their influence on the sub-conscious mind by association, and at the same time they

have determined and been correlated with habitual and instinctive actions, requiring but little conscious effort and expenditure of neural energy.

The delicate granules filling the nerve cells have been termed "neuro-bions," as if they were independent living units, but this is theory. It is, however, conceivable that violent concussion transmitted to the cerebro-spinal fluid, which forms the circumambient medium of such a complex mechanism as the living nerve cell, could cause a violent oscillation of these neuro-bions and a loss or disturbance of their functions of variable duration according to the severity of the shock.

Oxygen and Consciousness

It is known that a continuous supply of oxygen is essential for consciousness. The bulk of the cortex is supplied by the internal carotid arteries; compression of these arteries causes loss of consciousness in about five or six seconds. Histological investigation tends to show that the intercalary neurons have no store of oxygen in their cytoplasm; they depend, therefore, upon a continuous renewal of the oxygen in the circumambient fluid; consequently, as soon as the capillary circulation ceases, they feel the effect of lack of oxygen and cease to function, causing dissociation to occur. It may be hypothesized that a violent emotion such as fright can, by its influence on the vaso-motor centre and the heart's action, causing a fall in the blood pressure, produce an immediate lowering of oxygen tension in the fluid, and thereby suspension of function of the intercalary neurons of the cortex, followed by dissociation of the cortical perceptors and loss of consciousness. In many of the disorders of functions and loss of functions of the central nervous system resulting from shell shock, using that term in its widest sense, there occur symptoms of cortical

dissociation—*e.g.*, cortical blindness, deafness, mutism, and paralysis.

The symptoms of headache, weariness, loss of power of concentration, irresolution and mental fatigue, constituting a neurasthenic condition so frequently found as a result of shell shock, may be explained by the acquirement of the habit of drawing on the reserve of neuro-potential, and being unable through insomnia or sleep disturbed by terrifying dreams, worry, and anxiety to restore the balance and return to the normal conditions of automatic renewal of nervous energy as fast as it is used.

Physical Shock and Psychic Shock

Physical shock accompanied by horrifying circumstances, causing profound emotional shock and terror, which is contemplative fear, or fear continually revived by the imagination, has a much more intense and lasting effect on the mind than simple shock has. Thus a man under my care, who was naturally of a timorous disposition and always felt faint at the sight of blood, gave the following history. He belonged to a Highland regiment. He had only been in France a short time and was one of a company who were sent to repair the barbed wire entanglements in front of their trench when a great shell burst amidst them. He was hurled into the air and fell into a hole, out of which he scrambled to find all his comrades lying dead and wounded around. He knew no more, and for a fortnight lay in hospital in Boulogne. When admitted under my care he displayed a picture of abject terror, muttering continually "no send back," "dead all round," moving his arms as if pointing to the terrible scene he had witnessed.

Different Forms of Shock. Theories of Causation

According to Crile the essential pathology of shock is identical, whatever the cause. Crile further says—

“ . . . When the kinetic system is driven at an overwhelming rate of speed, as by severe physical injury, by intense emotional excitation, by perforation of the intestines, by the extension of an abscess into a new territory, by the sudden onset of an infectious disease, by an overdose of strychnine, by a Marathon race, by a grilling fight, by foreign proteins, by anaphylaxis; the result of these acute exacerbations of the kinetic system is clinically designated shock, and according to the course is called traumatic shock, drug shock, etc.”

Had Crile written this passage in the last year or two he would have added “ shell shock.”

There are two forms of shock, viz. *Primary*—when the exciting cause produces an immediate collapse, and *Secondary*, when it comes on some hours later.

There are many theories regarding the causation of shock, but whatever theory is accepted a refractory condition of the vital autonomic centres of the medulla must exercise a predominant influence in the causation of shock.

Von Monakow, in discussing the subject of shock in relation to diaschisis, points out that in apoplectic shock the vital centres of the medulla (cardio-vascular and respiratory) are unaffected.

In surgical shock he says microscopic investigation affords no satisfactory evidence of the cause of death. I have recently received four brains of soldiers who died from severe wound shock. All exhibited to the naked eye evidence of marked cerebral anæmia, and three out of the four were very soft and œdematous—a condition very similar to that which is found in experimental anæmia of the brain in animals.

There are two theories of shock, the vascular and the neuro-pathological.

The supporters of the former attribute the shock effects to the sudden fall of blood-pressure, general vascular paralysis, caused by a reflex vagus irritation and arrest

of the heart's action in diastole. Vascular paralysis, however, von Monakow asserts, cannot possibly explain all the phenomena of shock.

Goltz favoured the neuro-pathological origin of shock, and considered that it was the result of excessive stimulation of sensory nerves whereby severe molecular changes were induced in the nerve cells.

In wound shock the most essential cause would appear to be a harmful excitation of the autonomic centres of the medulla (cardio-vascular and respiratory), so that they become refractory to the normal physiological excitation, and this occurs without any microscopic histological change in the nervous centres. This may be true for primary shock in which fatal collapse immediately follows the excitation, but not for secondary shock (*vide* pp. 38-46).

Sight and hearing may be the avenues of excitation in exceptional circumstances in which psychic shock produces fatal collapse, in contradistinction to surgical shock, in which painful stimuli are conveyed to the brain and produce a refractory condition of the medullary autonomic centres. The influence of the emotions on the autonomic centres and the endocrine glands is well known. The psychology of the emotions, according to the James, Lange, Sergi theory, is that the feeling of the emotion does not precede but follows the reaction of the autonomic centres. Whether this theory be true or not, it is certain that the emotion is, as the word implies, the sum of the effects of the excitation producing feelings of which we are conscious. The perceptual feelings which arouse the emotion of anger and fear excite or inhibit the functions of these medullary centres. In psychic shock a persistence of the refractory condition of the vital centres may occur; so that if we assume that psychic shock is primarily due to a reflex nervous excitation producing a refractory condition of the vital autonomic centres, the

consequent sudden fall of blood-pressure is the explanation of the loss of consciousness. But the autonomic centres not only control the circulation and respiration, but also the endocrine system of glands, and Crile brings forward considerable evidence to show that there is an interrelation of the brain, the thyroid and the adrenals, which may be regarded as the master key to the automatic actions of the body, that is "through the special senses, environmental stimuli reach the brain and cause it to liberate energy which directly or indirectly activates certain other organs and tissue, among which are the thyroids and adrenals."

The work of Cannon and Elliot has shown that in anger and fear there is an increased quantity of adrenalin discharged into the circulation. The instinctive protective reaction in a struggle for life is either fight or flight, both of which require an increased activity of the whole neuromuscular system. The adrenalin raises the blood-pressure and mobilises sugar from the glycogen store in the liver. This automatic instinctive reaction is brought about by an excitation of the autonomic centres in the medulla conveyed to the suprarenal glands by the splanchnic nerves. If, however, there is a refractory condition of these centres, there will be a failure to liberate neural energy, and the signs of paralytic fear or psychic shock will be the result.

An important cause of shock according to Crile is exhaustion of neural energy; he attributes this exhaustion partly to accumulation of fatigue products causing an acidosis. He also lays great stress upon the exhaustion of the functions of the adrenal glands in the production of neural exhaustion.

Crile has described the disappearance of the Nissl granules in the Purkinje cells of the cerebellum in shock, and especially has he noted that the cytoplasm of these cells stain with the acid eosin dye rather than the basic dye. I have found the same cell changes in cases of shell

shock and traumatic shock from an extensive burn, a fact which supports Crile's theory that there is exhaustion of the kineto-plasm of the Purkinje cells which are rightly believed to play an important part in reinforcing muscular action.

Moreover, the apparently more marked chromatolytic changes found in the cells of the vago-accessorius nucleus than in the cells of the adjacent hypoglossal nucleus, point to exhaustion of the kinetoplasm in neurons which are active during immobility of the skeletal muscles. But too much importance cannot be attached to this observation, for the cells of the vago-accessorius nucleus in the normal condition do not show the Nissl granules so well as the larger cells of the hypoglossal nucleus; consequently the disappearance of the granules may occur more readily under the same conditions. It is difficult to estimate the influence of neural exhaustion resulting from activity *per se* by comparative histological appearances of different groups of functionally different nerve cells. However, the histological examination of the central nervous system in these cases of shell shock, wound shock and shock from extensive burns, shows that a fall of blood-pressure and consequent anæmia of the brain is the most important factor in the production of fatal shock.

Bayliss in his recent Lectures on "Intravenous Injection in Wound Shock" discusses the question: "What is the actual nature of wound shock, and especially what is the immediate cause of the low blood-pressure apart from hæmorrhage?" He admits that it is still obscure, but he excludes the following conditions.

ACAPNIA (DIMINISHED CARBON DIOXIDE IN THE BLOOD), because the respiration is not of such a kind as to result in excessive removal of carbon dioxide.

ADRENAL EXHAUSTION, because adrenalin is in excess in the blood when shock comes on. May this, however, not be due to the fact that it cannot be utilised?

EXHAUSTION OF NERVE CENTRES, because reflexes are not diminished to any important degree except when the blood-pressure has remained at a low level sufficiently long to paralyse the centres from want of oxygen.

INSUFFICIENT ACTION OF THE HEART, because when the arterioles are constricted by a dose of adrenalin the heart is quite able to raise the blood-pressure to a high level. But if, as is stated, there is excess of adrenalin in the blood when shock comes on, why does not this maintain the efficiency of the heart's action?

PARALYSIS OF ARTERIOLES OR VEINS, ESPECIALLY OF THE ABDOMINAL AREA, "because direct observation in the course of abdominal operations fails to show any abnormal distension."

He admits that the cause of shock is still obscure, but favours the Exœmia hypothesis of Cannon; which is "that there is an accumulation and stasis of blood in capillary areas so that it is removed from currency as effectively as if lost to the exterior." Whether there has been hæmorrhage or not, there is a deficiency of blood in the circulation, and the result of this is that there is a low arterial pressure and a failure to supply the tissues with their normal requirements in oxygen.

The pathological changes which take place in cells when insufficiently supplied with blood are well known, and Bayliss cites: "The suppression of renal secretion, the failure of cardiac contraction below about 90 mm. of Hg. (Marckwalder and Starling) and the changes in the nerve cells." In cats he finds that the vaso-motor centre loses its reflex excitability after one or two hours of an arterial pressure of 60 mm. The respiratory centre fails earlier. Many of the symptoms of shock disappear when the blood-pressure is raised. His experiments show that it is important to increase the blood supply and oxygen supply to the tissues, especially to vital organs such as the nerve centres and the heart.

His conclusion regarding acidosis as a cause of shock is summed up in the following sentence: "On the whole I am compelled to conclude that 'acidosis' is not in itself a serious factor in shock, and that alkaline injections are not called for."

He recommends the intravenous injections of gum solution for the treatment of wound shock. He deprecates the use of vaso-constrictor drugs, for, apart from their transitory effects, the result is actually a diminished blood supply to the tissues, because the rise of blood-pressure is obtained by narrowing the arterioles which convey.

Doubtless a combination of factors is responsible for traumatic shock. There is a great difficulty in differentiating the symptoms of emotional from commotional shock. The absolutely sudden onset of emotional shock by a horrifying sight, apart from war conditions, can only be explained by a sudden fall of blood-pressure, by arrest of function of the vaso-motor centre. This fall of pressure is followed by cortical anæmia causing loss of consciousness and cortical dissociation, which dissociation in a neuropath may persist in whole or in part, causing psychic deafness, blindness, mutism and amnesia.

If we accept Crile's theory we can understand why a normal neuro-potentially sound individual may from prolonged stress of war become so run down in kinetic reserve energy that an emotional shock suffices eventually to produce collapse, which, if not fatal, at any rate causes a condition of neurasthenia of considerable intensity and duration.

I have been struck by the fact that quite 10 per cent. of the cases of shell shock have presented mild symptoms of Grave's disease, an indication that the endocrine glands are profoundly affected.

The Nature of High Explosives and Forms of Projectiles

Sir Anthony Bowlby, in the Bradshaw Lecture on "Wounds in War,"¹ called attention to the nature of high-explosive shells and their terrible effects. "These shells vary in weight from a few pounds to about a ton, and they consist of a thick iron case containing in a central cavity a violent explosive charge. The latter is, in the case of German shells, trinitro-toluene, and may contain as much as 200 lb. of this explosive. Such shells are burst upon percussion by a detonator, which acts by the impact of the shell upon the ground or on some other object. These shells do not contain bullets, and the injury they do is in chief part by the jagged fragments into which they are split by the explosion, and also to some extent by the impact of portions of buildings, such as stones or bricks, which are scattered with immense force by the violence of the explosion. [He might have added sandbags forming the parapet of a trench or the roof of a dug-out.] The fragments of the shells are always very rough and jagged and of every variety of size and shape. For example, the base of a 17-inch shell may weigh 150 lb., and if it struck the body of a man would completely destroy it. Other fragments may weigh a few pounds and may tear off a limb or crush it to pulp, while in the smaller shells there may be scores of fragments about the size of the end of the finger or much smaller. It must also be borne in mind that the mere explosive force of the gases of a large shell exercises great powers of destruction. The expansion of the gases is sufficient to kill, and in the only case in my experience in which an autopsy has been made the brain was the seat of very numerous petechial hæmorrhages." This brain, by the kindness of Professor Arthur Keith, has come into my possession, and the result of the microscopic examina-

¹ *The Lancet*, December 25, 1915, p. 1385.

tion I shall deal with fully later. Suffice it to say that the appearance it presented led me to suspect CO poisoning. But high explosives are used also in mines, and in various other forms of projectiles, such as bombs of immense size dropped by *aëroplanes*, *aërial torpedoes*, whizz bangs, and grenades. It is, however, the big shells, bombs and mines which are so deadly in producing fatal or serious effects on the central nervous system without visible external signs of injury.

The following cases show the great force generated by high explosives :—

A lieutenant under my care told me that he was in a communication trench when an *aërial torpedo* exploded close to him. He felt a great pressure against him; it was soft, but sufficiently powerful to knock him down unconscious. He did not know how long he was unconscious, but thinks it must have been an hour. When he recovered consciousness he got up and was helped away. His head felt as if it would burst, and ever since he has had a whizzing in the left ear and dizziness. Dreams of bombs and *aërial torpedoes* bursting. There was no parapet to blow down on him.

A captain in the R.A.M.C. told me that a large shell burst at his back and he was blown fifteen yards by the *aërial disturbance*.

An R.A.M.C. officer at the battle of Ypres had a shell explode near him. He was not hit, but lay unconscious for six hours. He recollects the shock of the shell as he went out of the dressing-room. For some days he suffered with severe headache and soreness of back of head and down the spine; the lower extremities felt heavy, but there was no loss of feeling. He had retention of urine for a day only, and around the body there was a pain like an appendix pain. He rapidly recovered.

Theories Regarding Causation of Instantaneous Death of Groups of Men

At various times, from the earliest periods onwards in the war, journalists have given vivid descriptions of shell fire causing instantaneous death of groups of men. Ashmead Bartlett, in his graphic description of fighting in the

Dardanelles, relates what he found in "A Valley of Death." "In one corner seven Turks, with their rifles across their knees, are sitting together. One man has his arm around the neck of his friend and a smile on his face, as if they had been cracking a joke when death overwhelmed them. All now have the appearance of being merely asleep; for of the seven I only see one who shows any outward injury." How can we explain death without apparent bodily injury, yet so instantaneous as to fix them in the life-like positions and attitudes thus realistically described? Did rigor mortis come on immediately, and what was the cause? Officers and soldiers have told me that they have felt ill and vomited with the gases generated by these high-explosive shells. A Canadian officer told me that in the first gas attack made by the Germans he felt ill and vomited with the gases generated by the high-explosive shells. The smell has, like that of bananas, a faint sickly odour that made him feel ill and vomit, and quite different to the "gas." In considering the causation of fatal shell shock without visible sign of injury it is necessary, therefore, to take into account chemical changes in the atmosphere together with the physical forces generated by the explosive. The effect of the emanation of a poisonous gas was the explanation at first given for instantaneous death without physical sign of injury; it was widely bruited about that turpinit, a French high explosive, produced a deadly gas which would be quite capable of producing sudden death without visible signs of injury; but the question even then arises, Why should the body remain in a life-like position? Many authorities regard it as much more likely to be due to the effects of concussion on the nervous system. Cases that have recovered after severe concussion without visible sign of injury may, nevertheless, have received physical concussion by sandbags blown down from the parapet into the trench, or, if the shell burst in a dug-out, the earth may be driven down with great force, burying the inmates.

A case, however, came under my care, in which there was no history of this happening, from No. 6 C.C.S., 24-25.9.15, as follows :—

“This man was blown up by a shell and was found in the dug-out with his two comrades, both of whom were dead. While here he has been quite insensible to all questions. He has been in a cataleptic state, with at times convulsive seizures. His light reflexes are present.”

He was removed to No. 30 C.C.S.I., and further notes state : “Reflexes very active. Urine drawn off one pint ; when tested showed marked albumin. Both pupils widely dilated. Speaks incoherently occasionally. There is *no outward evidence of any injury* or symptoms of pain anywhere.” Five days later he was admitted to the 4th London General Hospital. He complained of a strange feeling in his head, and sweated profusely. He was terrified when the corporal in charge shook him to try and stop his shouting and mumbling. He complained of severe headache of the vertex, shook a good deal, and said everything in front of him looked blurred. He could hear and comprehend what was said to him, and spoke in reply to questions ; subsequently he made a complete recovery.

The fact that there was albumin in the urine when it was drawn off and no visible sign of injury suggests that inhalation of noxious gases in a closed space was an important contributory cause of the death of his two comrades and of the severe temporary symptoms which he manifested. But, it might be argued, if poisonous gases generated by the explosion caused death, it is only by inhalation while the man is lying on the ground unconscious or partially buried, and this would not account for the sudden death where groups of men are found fixed in the last act of life. M. Arnoux, a French civil engineer, has studied this question, and has suggested another theory which is extremely interesting. A pocket aneroid barometer carried by an officer had been exposed to an explosion of the kind referred to, and was put out of working order by the force of the concussion. M. Arnoux had the aneroid repaired ; he then placed it under the reservoir of an air pump and exhaust

until he had produced the same effect on the aneroid as was observed before it was repaired. He calculated from observations and experiments that the dynamic pressure exerted by the surrounding air on bodies within a few yards of the exploding shells had amounted to over 10,000 kilos. per square metre. Men standing close to the exploding shell would be blown into the air or dashed against the ground with great violence, but in the case of men leaning against the side of a trench wall only the static depression could affect them. What, M. Arnoux asks, would be the effect on the human organism of so powerful and so sudden a decompression? It would, he answers, be similar to that which causes the deaths of aëronauts who make too rapid an ascent or of workers in compressed air caissons who leave their caissons too quickly and without taking proper precautions for their slow decompression, namely, the sudden escape from the blood of bubbles of air and CO_2 , which would produce capillary embolism throughout the body and cause sudden death. M. Arnoux's theory is, then, that the sudden increase of atmospheric pressure produced by the explosion is capable of producing an immediate increased absorption of air and CO_2 by the blood, followed by a sudden liberation on return to normal conditions.

Surgeon-General Stevenson,¹ commenting upon the theory of M. Arnoux, asks: "Is it possible that a sudden increase of atmospheric pressure, lasting only a fraction of a second, no matter how great it might be, could so charge the blood with gases that their discharge into the blood stream when the pressure ceases would cause death in the same manner as a too rapid return to ordinary atmospheric pressure in caisson workers?" He advocates the theory of concussion of the central nervous system as the most satisfactory explanation; the water jacket of the cerebro-

¹ "Note on the Cause of Death due to High-Explosive Shells in Unwounded Men," *Brit. Med. Journ.*, September 18, 1915, p. 450.

spinal fluid serves as a protection to the vital centres of the medulla under all ordinary conditions of *commotio cerebri*. But in these cases (as M. Arnoux's experiments prove) we are dealing with extraordinary conditions of atmospheric pressure : a pressure force which we believe is sufficient to cause a temporary loss of consciousness, temporary blindness, deafness, paralysis, and loss of speech without any visible signs of injury. If the functions of the higher centres are for a time instantaneously suspended by the shock, it is conceivable that in the severest cases the functions of the vital centres of the medulla may be instantaneously suspended by its concussion ; moreover, the hæmorrhages in the corpus callosum and the basal ganglia found in the brain referred to might, accepting this view, be explained by the fact that the ventricles are filled with incompressible fluid to which the violent shock is transmitted.

The cases that have recovered after severe shell shock very rarely show signs or symptoms of organic disease.

But suppose the air is charged with carbon monoxide and oxides of nitrogen, would it not be possible for the man to inspire enough of these gases to cause instant death ? I wrote to Professor Leonard Hill on this subject, and I received the following very interesting reply :—

“ The explosion of a big shell in a trench, dug-out, cellar, or other confined space must, I think, instantly deoxygenate the air and produce a high concentration of carbon monoxide and oxides of nitrogen. The inspiration of a man at the moment of explosion may introduce enough of these gases to cause death from want of oxygen. If he is fatigued his muscles will be in the condition to go into rigor on the sudden deprivation of oxygen. It would be of great interest to get samples of blood from men killed by shell shock. I do not see how the alteration of air pressure can do more than act on the gas in the guts and on the lung. The sudden compression of the lungs by several atmospheres must be considered. The pressure will probably act quicker through the wall of the thorax than down the

trachea. I do not see how a sudden squeeze of the thorax is going to do any harm, and the pressure will be equally distributed through the fluids of the body in all directions, and it is not enough to break the thoracic wall by the sudden compression of the gas in the lungs. A copper ball with a glass tube sealed up full of air sunk in the deep sea is broken in when the glass tube bursts in spite of a free opening into the copper ball. I imagine the thoracic wall might be broken in by a sufficient sudden pressure. The elasticity of the atmosphere is such that this does not occur. I once carried out some experiments on the effect of exploding heavy charges of guncotton on pigs. A few feet of air was enough to save the pigs from damage. When the guncotton exploded near the ground the soil, stones, etc., were converted into missiles, and these wounded the pigs. The lungs of these pigs showed some patches of emphysema, as if the sudden wave of air pressure had driven air from one part of the lung into other parts.

"I should say the men either die, as you suggest, from the gases—deoxygenation of blood—or else from concussion."

Also through Lord Sydenham I have heard from the Secretary of the Trench Warfare Department that it is possible that the partial detonation of a large shell containing, say, 50 to 100 lb. of T.N.T. would produce enough carbon monoxide in the immediate vicinity to give rise to the characteristic poisonous effects of this product.

General Description of the Signs and Symptoms of Commotional Shock

A soldier who has an inborn or acquired emotivity will sooner or later suffer with a psychoneurosis. A shell bursts near him, he sees the flash, is blinded by it, and remains functionally blind, or unable to open his eyes, or is affected by a continuous blepharospasm; he hears the explosion and is temporarily deafened by the noise and remains deaf; this cortical sensory dissociation of the

centre of hearing by diaschisis causes in many cases mutism. He is blown up, and perhaps falls heavily on the ground, or is buried with earth in a crater or dug-out, or a sandbag hits him. When he recovers consciousness he may be affected with a spasmodic tic or convulsive movement of a defensive nature, such as the dodging reflex; or he may be affected with one of the many forms of hysterical paralysis or contracture, the result of suggestion. These varied and multiform hysterical manifestations are frequently grafted on to the signs and symptoms of shell shock. Psychogenic in origin and due to emotional shock, these symptoms are curable by contra-suggestion; in true shell shock there is always a residual neurasthenic condition which persists for a long time and does not yield to contra-suggestion.

When the physical forces generated by the explosion are sufficient to cause physical shock as well as emotional shock the case is then complicated by two factors, viz. commotional shock and emotional shock. The Army Form W. 3436, which accompanies the evacuated soldier, gives information as to whether the shell burst so near him as to justify the assumption that commotion was the essential agent in the cause of the symptoms for which he was evacuated; this would be strengthened by the fact that he was unconscious, or so dazed as the result of the shock that he either had to be carried or taken to the clearing station, and especially would it be justifiable to classify the case as a "battle casualty" if he were buried and had to be dug out, or suffered contusions as a result of being blown up. Still, many facts show that individuals with an inborn or acquired emotivity might suffer so severely from "emotional shock" as to be rendered unconscious or so dazed as to necessitate them being taken or carried to the clearing station. It is, therefore, extremely difficult to decide from the symptoms alone whether the case is commotional or emotional, or both.

For a man neuro-potentially sound, after *prolonged stress* and anxiety of trench warfare, may become emotive.

The only way to decide is by a careful investigation of all the facts, notably the length of time the man has been on active service at the front and his conduct as a soldier prior to the occurrence of the shock. Another important piece of evidence is the loss of consciousness. The period of time varies from a few hours to a few days in the most severe cases. When consciousness is restored it does not, as a rule, remain clear continuously, for there may be relapses to unconsciousness or lethargy of mind. The patient (as a rule) suffers with some retrograde amnesia. If he recovers, or only shows neurasthenic symptoms and no signs of "conversion hysteria," the presumption is that the case is one of true shell shock, and may therefore be regarded as a battle casualty. It has been found that in commotional cases, as distinct from purely emotional shock, the cerebro-spinal fluid shows an increased pressure when lumbar puncture is performed; it has also been found that this operation relieves cerebral symptoms, such as headache; the fluid upon examination is found to contain albumin, and, in severe cases, blood. The reason for this is explicable if consideration be given to the microscopic investigation of the central nervous system in fatal cases (*vide* pp. 38-65).

Description of a Common Type of Commotional Case

When shells explode in or on a dug-out, where repercussion can take effect to a maximum degree, they cause much more serious shock effect than when they explode in the open. Following such an explosion a number of men may be found in the dug-out suffering with shell shock, and some perhaps dead, yet showing no external injury. They may be seated or lying on the floor,

crouching or curled up in various unnatural attitudes. Their muscles are flaccid and there is hypotony. As a rule they are unconscious, but consciousness may not be *completely* lost. The sphincters are relaxed, there is no real paralysis, but there is a lack of purpose and precision in their movements. The general sensibility is diminished, and when the disturbance of consciousness is not too profound to test the special senses it is found that all the perceptions are enfeebled. Those cases which are able to describe their visual sensations frequently complain of a darkness before the eyes. There is tremor in the hands, and the whole body may shake. As a rule both the cutaneous and tendon reflexes are brisk, even exaggerated. It has been noted by Roselle and Oberthur that at first the plantar reflex is extensor, and fanning of the toes may be obtained. The extremities are cold; a little later, when they have become warm the return to normal sometimes occurs in an unequal and irregular manner—one hand being red and warm, whilst the other is cold and blue. The patient is bathed in a cold sweat, and there may be an abundant flow of ropy saliva. The pulse is constantly slow, small and thready, even imperceptible, and the heart beats rapidly. There is, in fact, a condition of collapse. In favourable cases when the circulation is re-established the heart beats energetically and carotid pulsation may be seen. When the patient recovers consciousness, and this is the usual course of events, he complains of abdominal pain, or pain at the pit of the stomach, as if he had had a blow of the fist, or the pain may be in the chest. If he coughs, his expression denotes suffering, and the expectoration is a frothy mucus often tinged with blood. There may be bleeding from the ears or nostrils and small sub-conjunctival hæmorrhages; these signs and symptoms may not all be present, nor are they of equal intensity in all cases. For some days there is a clouding of consciousness, accompanied by

severe headache and extreme lassitude. The less severe and more favourable cases may not be returned to the base, but after remaining in the clearing station a short time they are able to carry on, but it is quite likely that they will break down shortly after returning to the front line.

The clouding of consciousness is persistent in the less favourable cases, and various psychogenic complications frequently arise, such as mutism, deafness, deaf mutism, hallucinatory delirium, or a state of mental confusion bordering on stupor; in the severe cases the patient may remain in a state of coma until death (*vide* p. 46).

Description of Severe Emotional Shock following Commotion

When a shell bursts in the open a man may be blown some distance and yet not lose consciousness, but a subsequent horrifying sight of dead and mangled comrades may act as a sudden emotional shock and cause loss of consciousness, with marked symptoms of commotional shock. The following case illustrates these points remarkably well. Here there was no repercussion, and although the man was blown some distance, he did not in consequence lose consciousness.

Private C—— R——, age 21, admitted straight from France. He was at Boulogne two weeks.

From his own statement he had recovered sufficiently to give an account of himself. It seems that this man went out in May 1915 and was admitted on the 28th June to the 4th London General Hospital, after being a fortnight in Boulogne, so that he could have been only a very short time, a week or two at most, at the front. The account he gave of his being knocked out is as follows:—

He was carrying sandbags in the company of thirty men in daylight and under shell fire. The explosion flung him into a deep hole, and he climbed out to see all his friends lying around dead. This was his first sight of death, and he keeps

seeing it again, both awake and asleep, with bright lights and bursting shells. He does not hear the shells, but sometimes the men shouting. He sometimes *dreams* that he hears the shells exploding and the shouts of men. He said that he had always felt sick at the sight of blood.

When admitted to the hospital he presented an aspect of extreme terror. He sat up in bed with eyes staring wide, pupils dilated, brow wrinkled, nostrils dilated, mouth slightly open, and muttering sounds. He moves his head from side to side with occasional moans and groans, and moves his arms as if indicating something lying on the ground, alternating this with a movement of his right hand to his forehead. He keeps saying, "You won't let me back." It is remarked that the movements become less when he is unobserved, and cease during sleep. He comprehends what is said to him. He does not suffer with cold or blue hands, and the pulse is fair. Some days later, when he was improving, he became violently agitated when he saw me with two other strange officers come near his bed. I told him we were doctors, and that he would not be sent back to the front. From this time onward he began steadily to improve. I came to the conclusion from his subsequent complete recovery that this man was naturally of a timorous disposition, and that his condition was largely shock and terror due to two causes, viz. the memory of dreams of his awful experiences of war, and the continuous fear of his being sent back to the front. He was subsequently transferred to Morden Hall, where he has completely recovered.

November 22, 1917.

NEURASTHENIA AND ACQUIRED EMOTIVITY

Name.—Private E—— F——. 7th Middlesex.

Age.—19,

Former Occupation.—Engine cleaner.

Heredity, etc.—So far as the patient knows, none of his family has had any nervous or abnormal tendencies. He is sensitive, quiet and thoughtful.

Army Life.—Joined up 25th July 1915. First went to France in May 1916. On July 5th of the same year, having received a slight wound in the right forefinger, and being "shaken up" by shell fire, he was sent to England for Home Service. In March 1917, having quite recovered, he was again sent to France. Was gassed on May 3rd and sent to the Base Hospital, suffering from loss of sleep and pain in chest. He recovered and towards the end of July returned to the front lines. On the 15th October, whilst out on patrol after nightfall,

he accidentally shot a comrade whom he "took for a Fritz." This caused him great uneasiness.

Symptoms.—He suffered from insomnia, lying awake and fearing to fall asleep lest he should dream of the accident. He also suffered from extreme depression about it. On October 26th he lapsed into a feverish state—which has been described as P.U.O. This state was accompanied by a continuous headache in the frontal region and by recurrent pains between the shoulders, below the small of the back, and at the posterior part of the legs.

The patient has no doubt that his worry was the cause of his nervous state.

The mixed commotional and emotional type is perhaps the commonest type; according to whether we regard the question of shock from an organic or functional point of view, so may the origin of conditions met with in shell shock be explained. My opinion regarding the relative importance of the organic factor to the psychogenic in respect to the symptoms of shell shock has changed with further knowledge. The psychogenic factor, in my judgment, is by far the most important cause of the consecutive phenomena.

Those cases of shock which recover fairly quickly may belong to two classes of functional disease, viz. hysteria and neurasthenia; the former cases are usually due to emotional shock, the latter to stress of war and commotion, but hysterical and neurasthenic symptoms are combined in a large number of cases.

The milder cases of shell-shock neurasthenia suffer with headache, insomnia, extreme sensibility to sudden noises, or bright lights, and many are troubled with terrifying dreams. They avoid crowds, they are anxious and easily fatigued by bodily effort, and sexual desire is diminished. In fact, there is evidence of an irritable nervous weakness combined with a mental preoccupation.

After the initial stage the physical signs of shell shock are less obvious. Sensibility has returned, the locomotor difficulties, for the most part, have disappeared. The

deep reflexes are brisker than normal. The pupils are dilated. The circulatory troubles remain. The blood pressure may be above normal, and the heart-beat forcible and rapid. There may be symptoms and signs of exophthalmic goitre.

Consecutive Phenomena of Shock

Before treating of the consecutive phenomena of shock, whether it be of commotional or emotional origin, or of both, the question may be asked, Why should a man affected by a strong emotion of terror or horror fall down unconscious, and subsequently suffer with symptoms similar to those produced where there is actual commotion? Moreover, another question is whether in the great majority of cases of so-called "shell shock" implying a physical cause the symptoms are not due to emotional shock. If so, they are psychogenic in origin and unattended by visible microscopic changes in the central nervous system. Certain cases have been recorded by Léri and others, which show clinically that the explosion of a large shell near a soldier may cause clinical signs pointing to organic disease, although there are no visible signs of injury.

Léri, in the *Revue Neurologique de Guerre*, describes three cases of hæmorrhages into the central nervous system from "commotion." The first case was a case of hæmatomyelia strictly limited to the first and second sacral segments resulting in paraplegia with absence of mobility, sensibility and reflectivity in both feet. The second case was as follows: a shell burst on the left side of a man and some hours later there followed for the first time a right-sided Jacksonian epilepsy; the subject fell on his hand, his head was not struck, and he did not lose consciousness. The third case was one in which the symptoms pointed to a lesion of the optic thalamus. The patient threw himself down on hearing the shell coming; he arose soon after the explosion and found that he was hemianæsthetic; this was followed by an oncoming of hemiplegia which became total with contracture; he then became uncon-

scious. The cerebro-spinal fluid contained blood. In another case the symptoms pointed to a lesion in the bulb.

These, however, have not been attended by post-mortem examinations and microscopic examinations of the central nervous system. I have had the opportunity of examining the brains in three other cases, and as these illustrate two distinct types of the fatal initial stage I will describe them, and contrast the macroscopic and microscopic findings.

CASE I

Clinical Notes

In this case a man developed (according to a note furnished by Captain J. London) a degree of nervousness on the Somme which he never lost, but was able to control for six months. Later, he was in an area which was subjected to an intense bombardment, during which, as far as can be ascertained, no gas shells were used. This lasted about four hours (February 22, 4 p.m. to 8 p.m.). Although he remarked to another man that "he could not stand it much longer," he did not give way until the following day, twelve hours later, when perhaps six shells came over (February 23, 8 a.m.).

He was not buried or gassed. One shell burst just behind his dug-out—namely, ten feet away—in the morning, but many must have been as near the previous day. Early symptoms were tremors and general depression. The later symptoms (February 22) were coarse tremors of the limbs, crying (February 23), inability to walk or to do anything. He would not answer questions—very like the hysterical manifestations of melancholia. The pupils were dilated. I was rather busy with some wounded at the time, and did not make a detailed examination.

A note by Captain Francis A. Duffield, R.A.M.C. (S.R.), states that the man was admitted to the field ambulance in the evening in a state of acute mania, shouting "Keep them back, keep them back." He was quite uncontrollable and quite impossible to examine. He was quieted with morphine and chloroform, and got better and slept well all night. In a later note, Lieut.-Col. F. J. Crombie, in command of the field ambulance, stated that the patient had at least two hypodermic injections of morphine while in the ambulance. Next morning he woke up apparently well, and suddenly died.

Now the effects of explosion in a dug-out are always greater than in the open, owing to the repercussion of the aërial compression and decompression. This commotional shock acting upon an individual already in an exhausted and emotive state was followed by an attack of acute maniacal excitement, and evidently visual hallucinations, for in his struggles he shouted out, "Keep them back," as if he saw Germans. So violent were his struggles that he had to be given chloroform and morphia injections. The notes state that he woke up apparently all right and suddenly died. Captain Stokes made the post-mortem examination. He noted a considerable hæmorrhage in the substance of the lower lobe of the left lung. This condition may have been due to the sudden aërial compression and decompression, for similar hæmorrhages have been observed in animals experimentally subjected to the shock of high explosives. The right heart was enlarged and dilated. The muscle was good and there were no valvular lesions. This suggested heart failure as the cause of sudden death. There was a slight bruise on the scalp, in the frontal region. The brain was congested and œdematous. There were subpial punctate hæmorrhages, but the subcortical white matter showed no petechial hæmorrhages. The cerebro-spinal fluid was blood-stained. He remarks in conclusion: "There was no gross lesion of the viscera, which might have been a cause of death; but though I have never seen a post-mortem examination on a man who has died from 'shell shock,' I consider the condition of the brain was consistent with that diagnosis."

Summary of Histological Changes ¹

VASCULAR CHANGES

The vessels of the pia-arachnoid membranes of the brain are congested, and there are scattered subpial hæmor-

¹ The full account of these changes was published in the *British Medical Journal*, November 10, 1917.



FIG. 6.—Hæmorrhage into the sheath of a vessel in the median raphe of the medulla. Magnification 170.

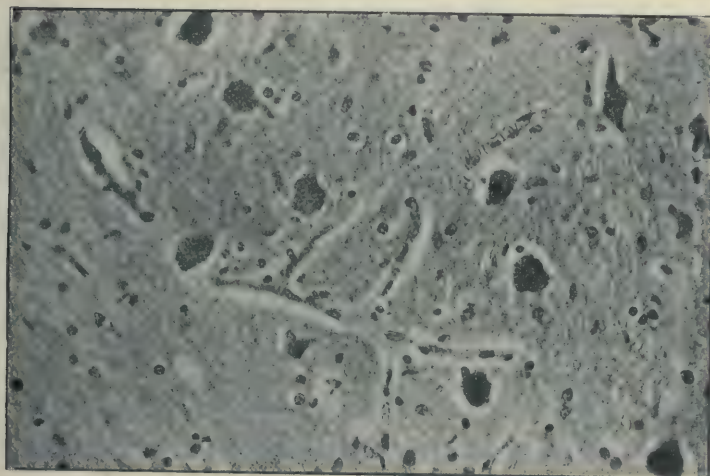


FIG. 7.—An arteriole breaking up into capillaries with dilated perivascular space. This space is in communication with the perineuronal space around the nerve cells. Magnification 300

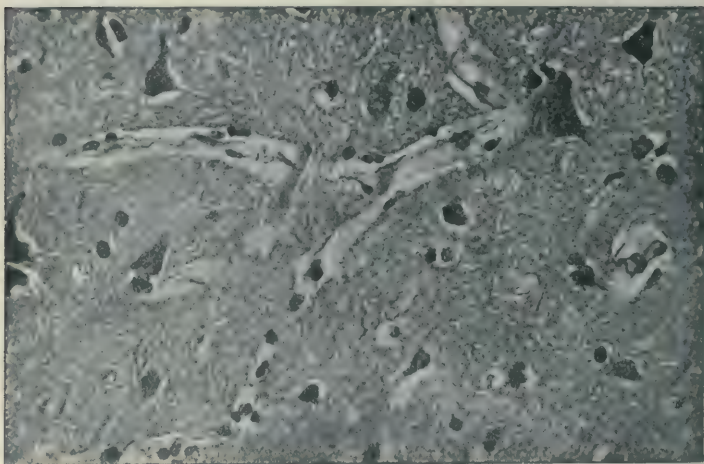


FIG. 8.—Section of cortex, Case 2. Dilated perivascular space around collapsed arteriole and capillaries. Dilated perineuronal spaces. Magnification 375.

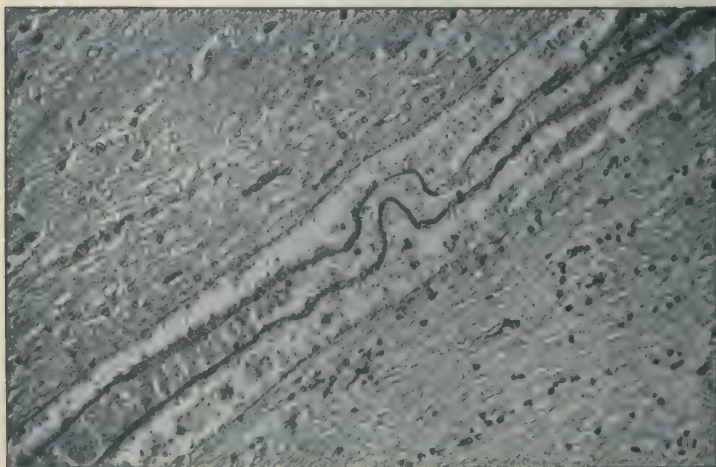


FIG. 9.—A small vessel cut longitudinally in the internal capsule. The vessel is filled with blood corpuscles; the perivascular sheath is seen dilated and filled with red blood corpuscles. Magnification 225.

rhages of microscopic size almost everywhere. In the white matter of the corpus callosum, the internal capsule, the basal ganglia, the pons and medulla, there are seen congested veins and hæmorrhage into the sheaths of the vessels with occasional extravasation of blood corpuscles into the adjacent tissues (*vide* Figs. 6, 9, 10). In the lower part of the medulla oblongata there is a vessel running into the anterior median fissure and raphé which has ruptured

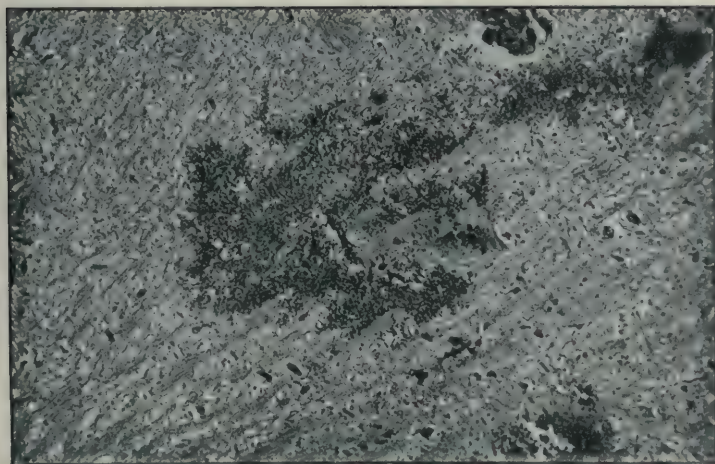


FIG. 10.—Hæmorrhages into the white matter of the pons.
Magnification 90.

and the blood has escaped not only into the sheath of the vessel but into the adjacent nervous tissue. This hæmorrhage is less than 2 mm. from the vago-accessorius nucleus (*vide* Fig. 6).

A remarkable histological feature of this case, also of Cases II and III, is the evidence of cerebral anæmia. In many regions the vessels appear collapsed and empty, the perivascular sheaths are dilated and appear clear and as if distended with a non-coagulable fluid, presumably cerebrospinal (*vide* Figs. 7 and 8). The appearances of the vessels, arterioles, venules and capillaries associated with engorged

congested pial veins accord in all respects with the appearances presented by sections of the brains of animals (monkeys) which have died after ligation of both carotid and vertebral arteries. Inasmuch as in this case death in all probability occurred from heart failure, this form of shock resembles in many ways shock from wounds and extensive burns in which there is a low blood pressure, cortical anæmia and changes in the nerve cells of a similar nature to those described in these cases of shell shock. I have recently examined the brain of a man who died of secondary shock twenty hours after suffering from an extensive burn. He lived for some hours with imperceptible pulse. The cortical anæmia was very evident, for although the pial veins were very congested with rupture and extravasation of blood in the subarachnoid space, the arterioles, capillaries and venules in the brain substance were frequently found empty and collapsed, and the perivascular sheaths dilated and clear, intercommunicating with one another and the perineuronal spaces.

THE CELL CHANGES

There is a generalised early chromatolytic change in the cells of the central nervous system. This change varies in intensity. The cells most affected are the small cells; in these the basophil substance has almost disappeared. In the larger cells the Nissl granules are smaller and not packed so closely together as normal. The small cells of the medulla and pons are slightly swollen and the nucleus is large and clear. Some groups of cells show the chromatolytic change more markedly than others; for example, the vago-accessorius compared with the hypoglossal nucleus (Figs. 11, 12).

Sections of the cerebellum stained with thionin and safranin show very unequal staining of the Purkinje cells with the basic dye (Fig. 13). This condition is very

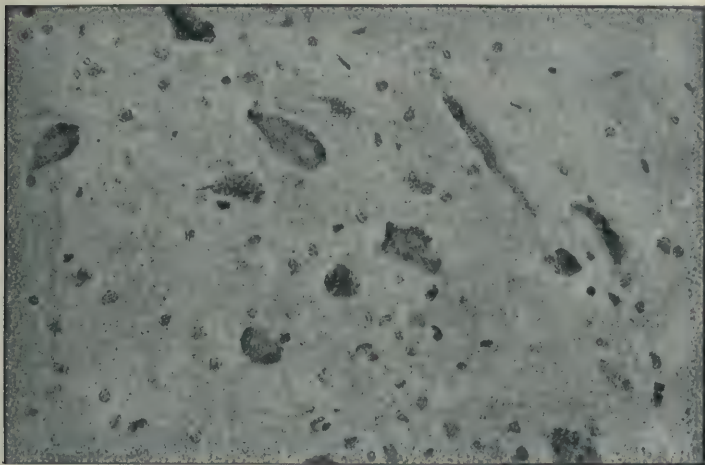


FIG. 11.—Cells of the vago-accessorius nucleus at the level of the calamus scriptorius. Observe the marked chromatolysis and eccentric position of the nucleus. Compare the same with Fig. 6. Magnification 400.

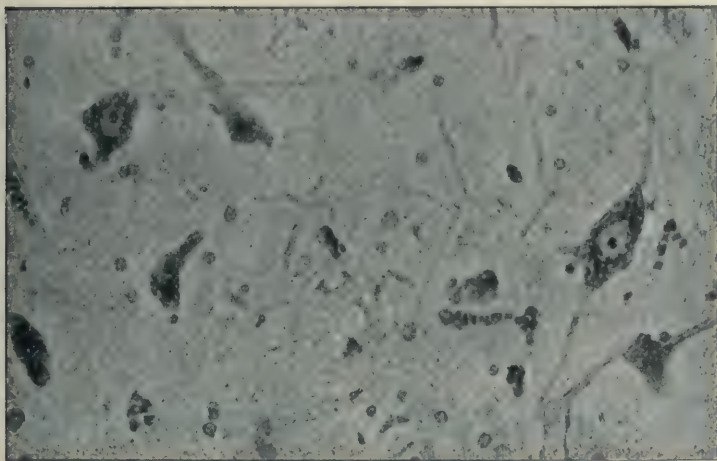


FIG. 12.—Cells of the adjacent hypoglossal nucleus, showing early slight chromatolysis. Magnification 400.

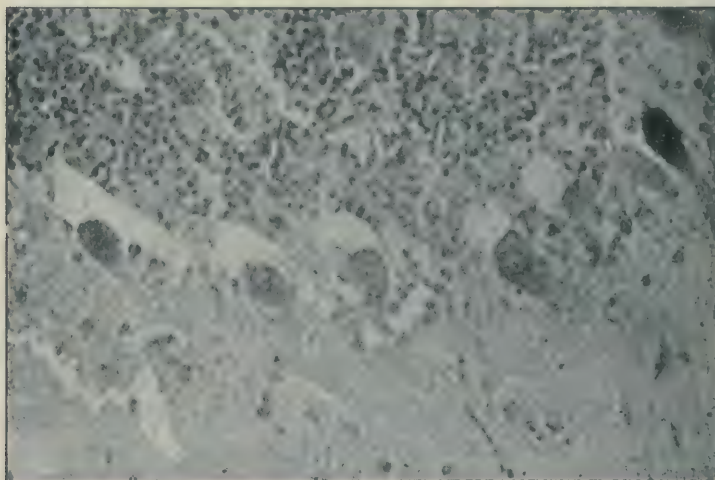


FIG. 13.—Section of cerebellum, Case I, stained with polychrome and eosin. Note the Purkinje cells are not all similarly stained. Two are stained faintly with the basic dye; the remaining ones are stained with the acid dye indicative of a chemical change. Magnification 270.

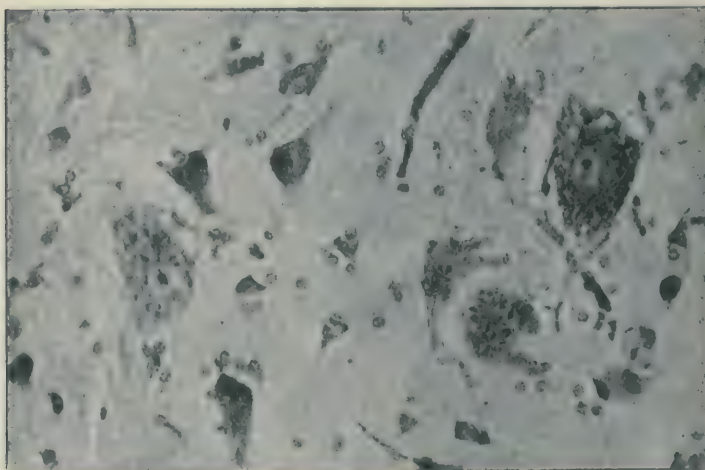


FIG. 14.—Betz cells of leg area. There is commencing chromatolysis of varying degree. The Nissl granules are not so closely packed together as in normal cells. The nucleus is larger and clearer than normal. Magnification 350.

similar to that described by Crile in the case of "a soldier who had suffered from hunger, thirst, and loss of sleep; had made the extraordinary forced march of 180 miles from Mons to the Marne; in the midst of that great battle was wounded by a shell; lay for hours waiting for help, and died from exhaustion soon after reaching the ambulance."

There are certain facts in the histological examination which we may correlate with what we know of the general symptoms of shell-shock neurasthenia with which this soldier suffered, viz. tremors and fatigability which were present before the final collapse. Can we associate these two general symptoms with any histological condition of the nervous system? Most of the motor cells of the spinal cord and stem of the brain showed a fair number of normal Nissl granules, there was therefore no evidence of exhaustion. Likewise, the large Betz cells (*vide* Fig. 14). The cells which uniformly showed a marked change in absence of Nissl granules, and in many cases stained with acidophil eosin instead of the basophil blue dye, were the large cells of Purkinje of the cerebellum. This change I have now found in all three cases, so that in all probability it is not a fortuitous condition. If there is exhaustion of the cells of Purkinje it may be presumed that as the cerebellum is essentially an organ of reinforcement of muscular action, the tremors and fatigability may be due to lack of this kinetic reinforcement. The maniacal excitement in this case may be associated with the pia-arachnoid hæmorrhages, the engorgement of the veins and the comparative empty condition of the arterioles and capillaries of the cortex. These vascular conditions may be associated with the weak action of the heart and low blood pressure occurring in the initial stage. The maniacal excitement is not unlike the delirium tremens of chronic alcoholism in which the higher inhibitory cortical structures are poisoned by the drug. In this case hæmorrhages into the

sheath of the vessels of the internal capsule were found, and also in the pons; which may account for the existence of the plantar extensor response and fanning of the toes in the initial stage. Strabismus, diplopia and nystagmus may occasionally be found in the initial stage, and these conditions may be due to small hæmorrhages in the stem of the brain; the effects of which soon pass off in the great majority of cases. The cause of sudden death in this case may be explained by the vascular congestion and hæmorrhages in the medulla oblongata, and the condition of exhaustion of the cells of the vago-accessorius¹ nucleus. Had this patient lived it is highly probable he would have recovered from the maniacal condition in a few days to a few weeks, and any signs of organic disease of the nervous system would have passed off in a short time. The condition of emotivity would have remained for a long time, and perhaps he would never have been the same man again—any more than a man who has been concussed by a severe blow on the head. The symptoms which would have persisted are those of neurasthenia, viz. tremors, severe headache, insomnia, terrifying dreams, ready fatigability by mental and bodily efforts, asthenopia, amnesia, especially loss of memory for recent events, rapid acting heart (possibly signs of affection of the endocrine glands in the form of a mild degree of hyperthyroidism).

CASE II

Clinical Notes

Captain Duffield reported that information obtained from the medical officer attached to the unit in which the man, a gunner in the Royal Garrison Artillery, was serving, was to the effect that he was sitting in a corrugated iron hut, fifty yards from some boxes of cordite cartridges, when a shell landed and

¹ It has been pointed out to me that the cells of the vago-accessorius at the level of the calamus scriptorius are too low down to be related to cardiac functions. Unfortunately the medulla at a higher level had been damaged.

exploded them. The man became unconscious at once; his breathing was stertorous; his body showed no signs of wounds.

On the same day he was removed to a dressing station and thence to a casualty clearing station; in the evening of that day he died. The medical officer there stated that the patient was absolutely unconscious, and could not be roused. His breathing was stertorous and slow; the pupils were equal and reacted to light; knee-jerks were difficult to obtain. He died shortly afterwards, and at the post-mortem examination the brain was removed, placed in spirit, and dispatched.

MACROSCOPICAL APPEARANCE OF BRAIN

On the upper surface of the cerebellum, the temporo-sphenoidal and left orbital lobes there was superficial hæmorrhage. On cutting up the pons, oval patches were seen as large as one-sixth by one-quarter inch; whether this is simple staining of hæmorrhage cannot be determined until a microscopical examination has been made. Portions of the mesencephalon and pons were taken for microscopical examination; the medulla oblongata was not sent.

MICROSCOPICAL EXAMINATION

Post-parietal.—Meninges: Marked congestion of all vessels of the surface of the brain with extravasation of blood into the soft membranes. In the grey matter of the cortex the perivascular spaces are dilated throughout, and the vessels, capillaries, veins, and arteries are for the most part empty. In the white matter no punctate hæmorrhages are seen; there is marked dilatation of the perivascular spaces; the capillaries, veins, and arteries are empty. In the cortex there is dilatation of the perineuronal spaces, which in many instances may be seen communicating with the perivascular spaces (*vide* Fig. 8).

Ascending Frontal.—Stained with thionin. The large pyramidal cells show pretty marked chromatolysis without swelling of cell; some of the Betz cells show commencing breaking up of the tigroid bodies; smaller pyramidal cells show undoubted swelling of nucleus and loss of pyramidal shape (very similar to that observed in experimental anæmia in animals) with varying degrees of chromatolysis. As a rule, the smaller the cell, the more marked is the change.

Left Orbital Lobe.—On the under surface there is extensive extravasation of blood into the substance of the brain and on the surface, and there is very marked dilatation of the perivascular spaces everywhere. The cortex is in a measure destroyed in one place; it shows very marked dilatation of perineuronal as well as perivascular spaces, which intercommunicate.

Corpus Callosum.—There is much congestion of vessels, and many have ruptured into the sheath, forming long, irregular branching, hæmorrhagic extravasations, but no sign of punctiform hæmorrhage. Betz cells seem rather shrunken than swollen in the *ascending frontal*.

Left Temporal Lobe.—Shows remarkable dilatation of the perivascular spaces, and there is a big globular hæmorrhage, and much hæmorrhage into the substance of the brain.

It will be noted that in this case the man was sitting in a corrugated iron hut fifty yards from the explosion. *His body showed no signs of wounds.* Being in a closed space, the man got the full effect of the aerial compression and decompression, and if the statement can be relied upon that there were no wounds on the body, we must assume that the forces of compression and decompression generated by the explosion were sufficient to cause the changes observed in the brain. But it is quite possible he may have been blown up and suffered with physical concussion without having wounds but not without contusions, for we know what terrific forces are generated by the detonation of large quantities of these high explosives.

CASE III

Another brain was sent to me by Lieut.-Col. Elliott in which the corpus callosum was torn at its posterior extremity presumably by concussion, for there was evidence of bruising of the scalp and hæmorrhage without any fracture being discovered post mortem. The man was brought down in the ambulance train unconscious, and died the same day. No notes accompanied him, therefore it was only presumption that he had been blown up and that the falx cerebri had cut through the corpus callosum. There was subpial hæmorrhage pretty general over the surface of the whole brain, and in the fourth ventricle there was a thin film of blood. On cutting up the brain it was noticed that there were punctiform hæmorrhages in the subcortical white matter, and especially were these numerous and coalescent in the centrum ovale near the region of laceration of the corpus callosum. Microscopic examination exhibited great venous congestion in the pia-arachnoid with rupture and hæmorrhagic extravasation. The blood in many places had penetrated the brain substance both in the cortex and the stem

of the brain, also, though to a less degree, in the cerebellum. The subcortical white matter showed numbers of punctiform hæmorrhages, and in the centre of these hæmorrhages were found vessels blocked by a hyaline thrombus such as is found in gas poisoning, so that it is possible the man suffered from concussion and gas poisoning. The vessels in the subcortical white matter, in the internal capsule, the pons and the medulla were congested, and many of the smaller of them had undergone rupture with escape of the corpuscles into the perivascular sheath. So that in this respect the lesion resembled the condition found in Cases I and II, but differed in the fact that there were punctiform hæmorrhages. The post-mortem examination was made so soon after death as to preclude the possibility of the changes to be described in the cells being due to any fortuitous cause. They were remarkable, and pointed either to a toxic condition and hyperthermia or possibly exhaustion.

The sections stained with Nissl or Leishman stain showed an absence of Nissl granules. The cytoplasm examined with an oil-immersion lens showed only a fine dust incrusting the fibrillary network. They have not swollen nor lost their contour. The nucleus appears large and clear. With Leishman stain the nucleolus is stained purple or pink, instead of blue. The intranuclear network has lost its bright-blue coloration, and appears, like the cytoplasm of the body of the cell and the dendrons, to be stained a dull purple colour. These changes, together with the hyaline thrombosis of the subcortical vessels in the centre of the punctate hæmorrhages, point to some other agent than the mechanical concussion, for they were not present in Cases I and II of known shell shock. Moreover (as in Case IV, p. 51, which I described in my Lettsomian lectures), the vessels showed in places definite signs of acute inflammation in the form of numbers of polymorpho-nuclear leucocytes and lymphocytes around and in the perivascular sheath.

It must therefore be presumed that in all probability, in addition to the physical effects of the explosion causing rupture of vessels, there was a toxic agent which had caused the uniform bio-chemical changes found in all the ganglion cells of the central nervous system and of the larger neurons, particularly the cells of Purkinje of the cerebellum.

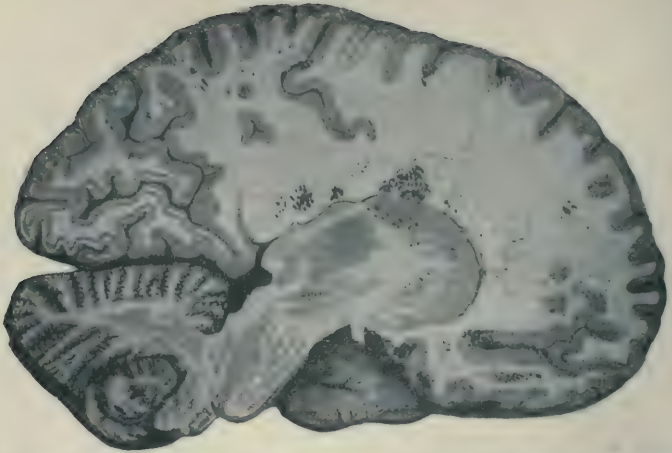


FIG. 15.—Section through the whole brain, Case IV, shell shock without visible injury, 1 inch external to the mesial surface. Punctiform hæmorrhages are seen in the white matter which have coalesced in the corpus callosum, corona radiata, and in the white matter of the hemisphere generally.

FIG. 16.—Vertical section through the left hemisphere in the frontal region, showing coalescence of hæmorrhages in the corpus callosum, internal capsule, and lenticular nucleus.

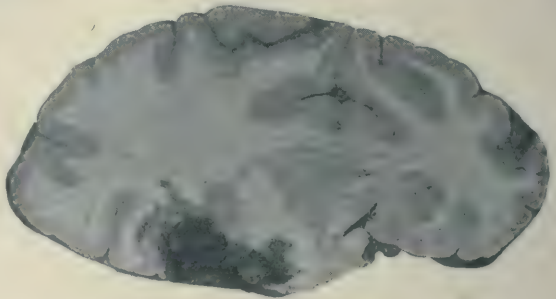
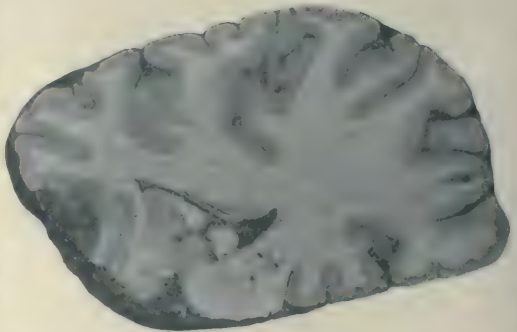


FIG. 17.—Vertical section through hemisphere, Case 1, showing a wedge-shaped area of coalesced hæmorrhages upon the under surface of the anterior part of the occipital lobe. This is the only region where the hæmorrhages had coalesced so as to form in the grey matter an area visible to the naked eye, but throughout the cortex, as in the case of CO poisoning, there are capillary hæmorrhages; at this situation the hæmorrhage has ruptured the grey matter and produced a subpial extravasation. The microscopic appearances of the hæmorrhages are seen in Fig. 18.



CASE IV

Fatal Case of Shell Shock and Contusion; Histological Changes in the Central Nervous System

Specimen received from Captain W. E. M. Armstrong, R.A.M.C., No. 7 Mobile Laboratory, B.E.F. Sent on from No. 1 Mobile Laboratory. No. 8 on Captain Armstrong's list. Brain of man (Figs. 15, 16, 17) admitted unconscious with history of having been buried by shell blowing in parapet. Remained stertorous for two days and died.

Post-mortem.—There is no wound of any kind on his body or head, and no visceral lesion. His ankle on one side was badly "sprained," but there were no fractures. The skull was unfractured, and no fracture of the base could be found. Brain shows multiple capillary hæmorrhage and (some slight) subpial extravasation. No other particulars.

Histological Examination of the Brain.—Throughout the white matter of the centrum ovale, and especially in the corpus callosum, internal capsule (Figs. 15, 16, 17) and cerebral peduncles, are multiple punctate hæmorrhages (*vide* Fig. 18). They also occur in the subcortical white matter and in the basal ganglia. In many places these hæmorrhages have coalesced into large areas, and in the parieto-occipital region there is a diffuse purple staining of the white matter around the hæmorrhagic area. Microscopic examination shows isolated capillary hæmorrhages in the grey matter; in the medulla there are only congested vessels, but no hæmorrhages. This appearance to the naked eye corresponds to that which I have described in CO poisoning. Sections of the brain were cut after hardening and embedding in celloidin and stained with hæmatoxylin eosin, van Gieson, and by Nissl method. The same microscopic appearances were observed as those seen in coal gas (CO) poisoning, only the hæmorrhages were more extensive. The case of coal-gas poisoning where the patient lived four days, instead of 48 hours, as in this case, showed in the cells of the medulla (Fig. 19) a marked chromatolysis with swollen clear eccentric nucleus, similar to the change observed in experimental anæmia of animals. It is most marked in the cells of the vagus nucleus, but more or less general throughout. In the cortex many of the Betz cells show a very marked chromatolysis, swelling of the cell and eccentric nucleus, while others in the immediate neighbourhood may possess a fairly normal amount of basophile Nissl granules (*vide* Fig. 19). Besides the above-mentioned changes many of the small vessels exhibited inflammatory changes. But all stages may be met

FIG. 18.—Photomicrograph of section of corpus callosum from case of shell shock, showing the capillary punctate hæmorrhages. In several cases a small white area of brain tissues is seen, in the centre of which is a small artery or vein. Magnification 20 diameters.

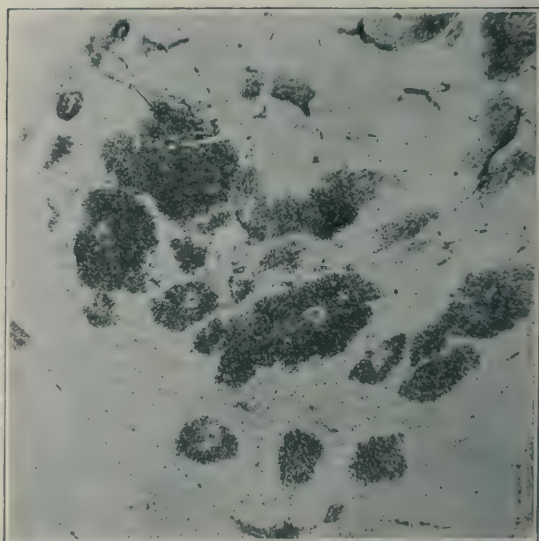
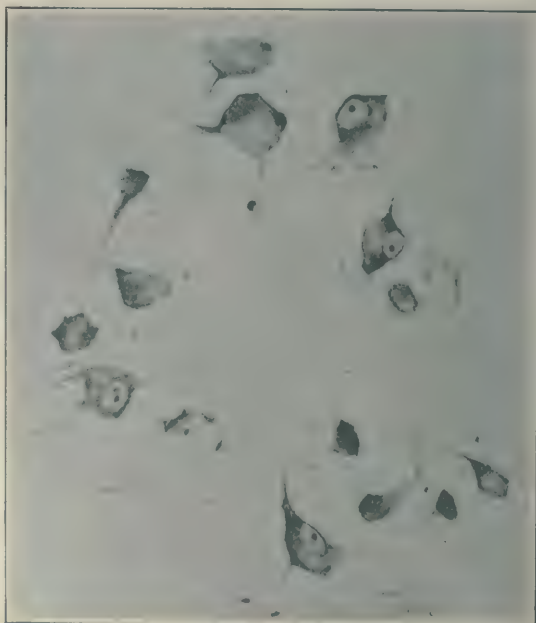


FIG. 19.—Section of medulla oblongata from case of shell shock with burial, stained by Nissl method, showing the swollen cells of the nucleus ambiguus. Observe the enlarged, clear, eccentric nucleus; the surrounding cytoplasm shows an absence of Nissl granules. In not a single cell is the nucleus seen in the centre as it should be. Magnification 450.



with. These photomicrographs show the above-mentioned changes which correspond with those due to deoxygenation of the blood in CO poisoning or in experimental anæmia by ligation of all four arteries. As I find the most extensive hæmorrhages, but no evidence of sudden death and swelling up of the axons as in the case of spinal concussion, I have come to the conclusion that it is possible this man was rendered unconscious by shell shock, and that while buried he was poisoned with gas.

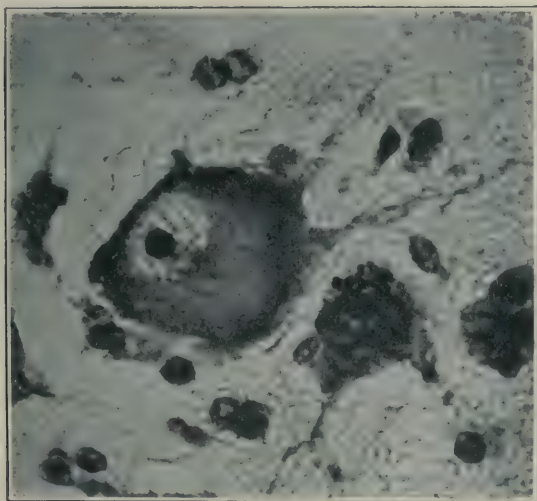


FIG. 20.—Photomicrograph of a Betz cell, showing swelling of the cell; disappearance of the Nissl bodies. The nucleus is clear, large, and eccentric; in the immediate neighbourhood are cells in which this change has not occurred. It is possible that hæmorrhage has ruptured the axon of this particular cell. Magnification 800.

Spinal Concussion

A number of cases of spinal concussion have come under my notice. Some have been under my care and have so far recovered that they could be discharged from the hospital. I will briefly relate one case in which I diagnosed spinal commotion and hæmorrhage.

Private C——, 8th Seaforths, age 20, was admitted January 5, 1917. He had had two years' service, and was six months

under fire. On December 22nd he was in a dug-out when an 8·6 in. shell exploded on the dug-out, blowing the back of it in. He was standing up at the time, and he remained in the upright position, never lost consciousness and was got out in a few minutes. He was sent to Havre and then on to the Maudsley hospital. Catheterised three days at Havre; upon admission he had incontinence of fæces and urine.

There was no evidence of bruising nor any tender spot over the spine; there was no evidence of paralysis of face or tongue. There was a marked weakness of the muscles of both arms; the paresis was more marked on the right than the left. He was able to lift his arm above the head, and to turn over in bed. The most marked loss of power was in the hands. There was only slight power of movement in the legs. No muscular wasting, no marked flabbiness. Patellar and ankle clonus on both sides. Plantar extensor response on both sides. Wrist tap and triceps jerk both easily obtained. Pupils normal. No ocular paralysis or nystagmus. Hearing and sight unaffected, also taste and smell. He complained of no headache, tremors, dreams, sweating or of anxiety. There was no evidence of neurasthenic emotivity. When asked how he felt the invariable reply was, "All right." In about a month he had recovered power over his bladder and bowels. The movement in the arms and legs had increased in power, and he was able to put his feet on the ground. Two months later he was able to stand and walk when supported by two men. Three months after admission he was able to walk with the aid of a stick and was sent home.

CASE V

Spinal Concussion from Burial; no Gross Injury, no Fracture and no Dislocation of Vertebrae. Macroscopic Haemorrhage in Cervical Cord; Characteristic Microscopic Changes. Paralysis of both Arms, Legs, and Intercostals, Anaesthesia; Consciousness retained until Death.

Lance-Corporal A—, admitted to No. 17 Casualty Clearing Station on September 11, 1915, suffering from paralysis. Captain W. J. Adie, R.A.M.C. (S.R.), writes:—On the morning of the 10th instant, during a heavy bombardment of one of the trenches, this man was buried in his dug-out under timber, sandbags, and earth. He was excavated within five minutes, and it was noted that he had lost the use of his arms and legs. He was conscious and rational. He did not complain of pain. I was not called to see the man as he had no wound, and there

were many serious cases needing attention. In the morning he arrived at the dressing station just as the ambulance was leaving and was put straight in. I regret that I did not see him. The patient was sent down on the early morning of the 11th to the 18th Field Ambulance, and told the medical officer that he had shell shock. His pulse was then 40 and temperature 97° F. He complained of pains in his head and back. On the same morning later he was admitted to the casualty clearing station, where Lieutenant Dew observed rigidity of his legs and noticed that he was in a state of "cerebral irritability," calling out, "Let me alone." I (Captain Adie) was asked to see him on that day, but he could not be found by the sergeant-major, so, having several other cases to see, I did not see him until the next day.

On the morning of September 12th he was seen at 11 a.m. by Captain Dennis and Captain Stokes. He was lying flat; his abdomen was rigid; he showed total flaccid palsy of both legs and arms. A feeble extensor response (easily fatigable) was obtained from the right sole, no response from the left. The cremasteric reflex was absent on the right side; was present, but easily fatigable, on the left side. The abdominal and patellar reflexes were absent. The sphincters were not paralysed. His breathing was shallow and laboured. The ribs were motionless. Sensation was completely absent on the limbs and on the trunk up to apparently the second cervical level, but his mental condition was too bad for the results to be very reliable. Heat and cold were indistinguishable.

At 12.30 p.m. I saw the patient. The orderly reported to me that the patient was continually asking to have his position shifted. I saw him propped up, when his abdomen was flaccid. He was obviously near death, and it was difficult to get much from him. He protruded his tongue normally at request. He complained of feeling sick and of being unable to get his breath; "I am tied up," he said. Speech normal. Total intercostal palsy. Pulse full, slow, 54. Complete flaccid palsy and anæsthesia of all limbs. Plantar response: left leg, normal; right leg, faint flexion of proximal phalanges. No difficulty in swallowing. No incontinence or retention of urine or fæces. Unable to get any history from him. He died at 1.30 p.m.

Post-mortem examination at 2.15 p.m. by Captain Stokes. Slight but not definite mobility of the fourth cervical vertebra. No dislocation or fracture of vertebræ found. No external wound. A good deal of intravertebral hæmorrhage while getting out the cord (? normal bleeding from venous plexus). No clot in the vertebral canal. Some hæmorrhage within the upper part of theca, but this probably got in from the cut end.

Hæmorrhages within cord in mid-cervical region and possibly in upper dorsal region. Cord preserved in 5 per cent. formol.

Description of Cord by Dr. Mott (September 17, 1915).—There are visible hæmorrhages in upper cervical region, extending about 1 inch on external surface of dura mater. On reflecting dura a subpial hæmorrhage can be seen $\frac{1}{2}$ inch in length, $\frac{1}{4}$ inch in breadth, over posterior surface of the cervical cord beneath the pia-arachnoid. The central canal at the level of the third cervical and about the level of the middle of subpial hæmorrhage contains blood about the size of a large pin head. This can be traced down to the upper part of the fourth cervical, and at the level of the lower part of the fourth cervical segment there is an obvious extension of the hæmorrhage into the right anterior horn. At the level of the fifth and upper part of the sixth cervical the hæmorrhage apparently extends throughout the whole of the grey matter. At the seventh cervical there is an obvious change in the grey matter, but the hæmorrhage is much less extensive. At the eighth cervical there is an apparent change in the whole of the grey matter, also in the first dorsal. The outline of grey matter becomes more distinct about the third dorsal, but throughout the dorsal region the naked-eye appearance suggests the probability of some change in the grey matter. Even in the lumbo-sacral region the grey matter does not appear quite normal in its outline. Subsequent microscopic examination of sections showed that the changes seen in the outline of the grey matter above described were due to some congestive œdema.

Histological Examination of the Spinal Cord.—The spinal cord was hardened in formol and cut after embedding in celloidin. Sections were cut and stained by van Gieson, Weigert Pal, and Nissl methods. The appearances presented corresponded with those described by Colonel Gordon Holmes in gunshot injury of the spine without penetration of the dura mater but causing concussion of the spinal cord. (*Vide* Figs. 21, 22, 23, 24, 25, 26, 27, with descriptive text). It is presumed, as there was no visible sign of injury, that the man was struck on the neck by a sand-bag, for he was partially buried. The fact that the subpial hæmorrhage was over the posterior column, and the damage affected especially the posterior column and the grey matter, suggests that a pressure wave of the cerebro-spinal fluid was set up by the concussion, and the grey and white matter lying between the fluid in the central canal and the subarachnoid received the full force of the shock. Had it been a segment higher, instant death from complete destruction of the phrenic

nucleus would have occurred. As it is, the microscopic examination shows that a partial destruction of "nucleus diaphragmaticus" took place (*vide* Fig. 25).

Dr. Sano, who has made a special study of the origin of the phrenic nucleus (diaphragmaticus), has been kind enough to look at these sections and indicate exactly the group from which the nerve arises: it is the median group

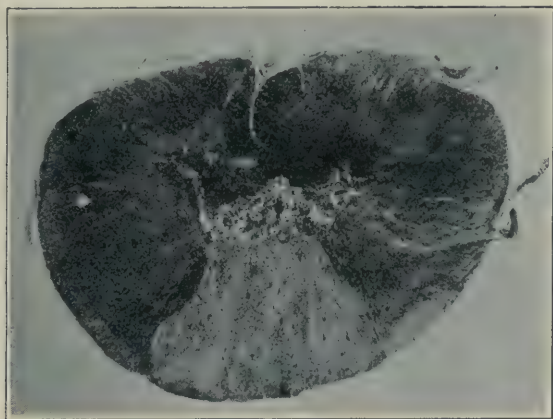


FIG. 21.—Section of the fifth cervical section of spinal cord of Case 5, spinal concussion without evidence of external injury. Observe the appearances of the grey matter and the posterior column, and the antero-lateral column of one side as compared with Figs. 22 and 23. This is at the seat of concussion. (In Figs. 21, 22 and 23, Weigert-Pal staining was employed.)

of the anterior horn. These cells are entirely destroyed in the fourth and fifth segment, but are present in the third. They show, however, as compared with the other ganglion cells in the anterior horn at this level, some chromatolysis, as if under the stress of increased activity the basophile kinetoplasm had undergone some disintegration without corresponding reintegration. The posterior column at the seat of the concussion presents a diffuse sieve-like vacuolation of the myelin fibres, such as has been described by Gordon Holmes. One sees also the



FIG. 22.—Section of the fourth cervical segment; observe the cavitation of the grey matter starting from the central canal and extending into the anterior horn and down the posterior horn of one side. It is only in these two fourth and fifth segments that gross macroscopic changes can be observed.

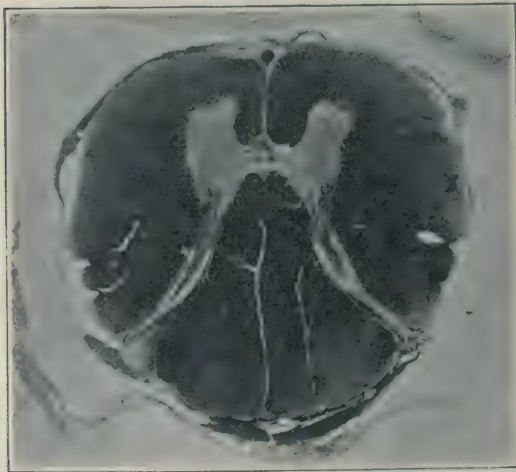


FIG. 23.—Section of the third cervical segment. No gross macroscopic changes are observable.

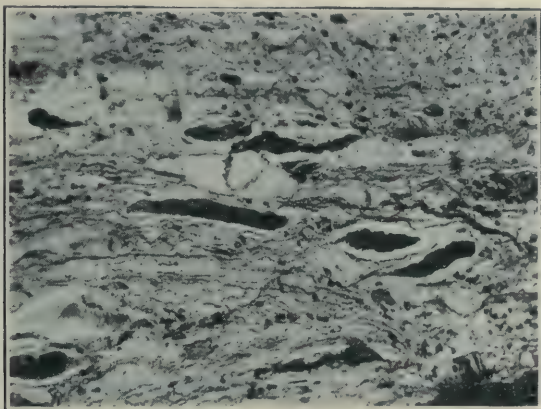


FIG. 24.—Longitudinal section of periphery of posterior column at the level of the fifth cervical segment; the dark stained swollen axons are seen. Magnification 200.

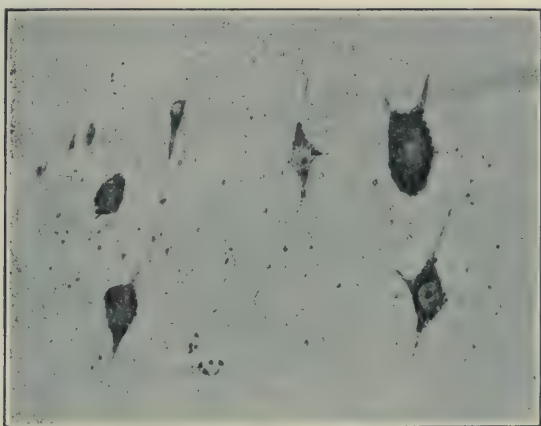


FIG. 25.—Section of third cervical segment of spinal cord case of concussion, stained by Nissl method, showing the median group of anterior horn cells corresponding to the nucleus diaphragmaticus, and they show a certain amount of perinuclear chromatolysis, but all the cells exhibit the Nissl granules. Even at the seat of concussion, the fourth segment, an external group of cells remain showing Nissl granules. Concussion, therefore, does not destroy the Nissl granules. Probably the cells of the nucleus diaphragmaticus show a certain amount of chromatolysis because they were continually discharging impulses along the phrenic nerves, and the few cells that were left of the nucleus had therefore much more work to do. Magnification 300.

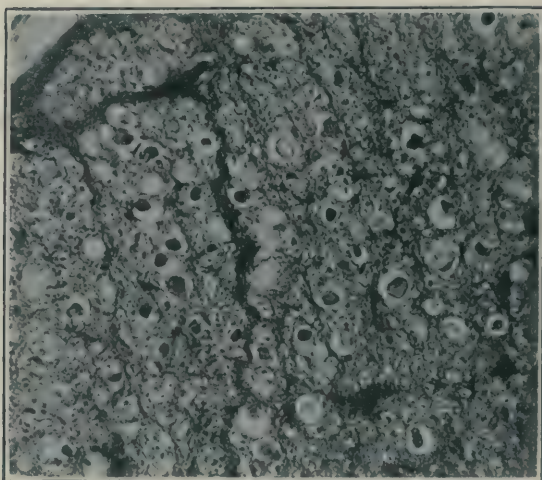


FIG. 26.—Section of periphery of posterior column at the level of the fifth cervical segment. Vacuolation of myelin sheaths and many swollen axons are seen. Magnification 300. Van Gieson staining.

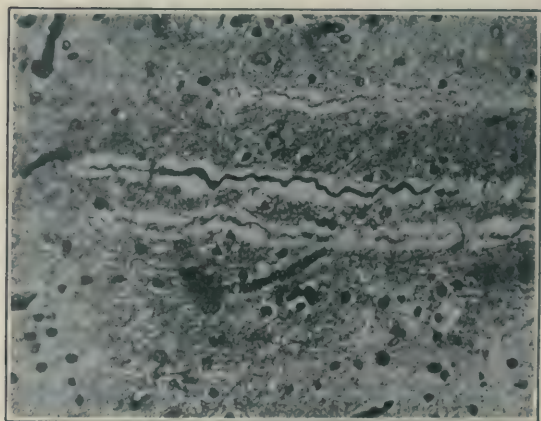


FIG. 27.—Myelinated projection fibres in the motor cortex. Three twisted axis-cylinders are seen; they are not swollen. Magnification 300.

enormously swollen axis-cylinders (*vide* Fig. 26). This also is seen well in longitudinal sections (*vide* Fig. 24). The shock may have been so great as to have killed the axoplasm; for, as Leonard Hill, in a letter to me, says: "A water pressure of between 300 and 400 atmospheres kills all protoplasm (excepting deep-sea fishes). Water enters into the muscle and swells it and turns it opaque. There are curious fractures produced in the muscle fibres. The myelin of nerve fibres is broken up by the water entering into these." Then he goes on to say: "In the case of a high-velocity bullet striking the spine, it seems possible that the cerebro-spinal fluid beneath the struck part may be instantly compressed and act as a solid body transmitting the blow to the cord. There cannot be time for the fluid to be displaced. There is, anyway, a water-pressure limit beyond which protoplasmic activity is destroyed, and I imagine bullets must produce this pressure, but I very much doubt whether air waves produced by shell-bursts can reach to such pressures as 300-400 atmospheres." It is quite possible that a sandbag hurled against the neck could produce this effect without producing visible injury. This sieve-like character of the white matter and the large swollen axis-cylinders are only found in the posterior column from the fourth to the seventh segment inclusive. There are hæmorrhages in the white matter of the posterior column as low as the seventh cervical. Below this segment no hæmorrhages are seen in the white matter, but congestion and small capillary hæmorrhages are found throughout the grey matter of the spinal cord. Since only about forty-eight hours elapsed between the concussion and death, there was no time for degenerative appearances of the white matter to occur; there was apparently a sudden destruction of a portion of the axons in the posterior column. No physical or chemical changes have occurred in their continuity above and below the seat of concussion, which

certainly would be shown in the long fibres of Goll's column, where a large number of these greatly swollen axons and vacuolated myelin sheaths are seen. Although there are hæmorrhages at the seat of the lesion in the posterior column, the greatest amount of hæmorrhage is in the more vascular grey matter, and, as the photomicrographs show, the destructive disintegration is very marked at the level of the fourth and fifth cervical (*vide* Figs. 21, 22); it is also seen to a less degree in the sixth and seventh. Shock, no doubt, interfered with the autonomic activity of the muscles of respiration below the lesion; it is remarkable that it did not produce a shock effect on the bulbo-spinal nuclei above. This shows how well protected they are from shock, also that a transverse lesion of the cord produces a shock effect down the efferent projection fibres and not up the afferents. It is noteworthy that this undoubted case of spinal concussion without visible injury accords in the histological changes with those described by Gordon Holmes. The blood contained in the area of hæmorrhage in the posterior column would soon be absorbed and give rise to the cavitation observed by Holmes in this region. I have seen a number of cases of spinal concussion caused by a bullet wound of the spine without penetration of the theca vertebralis in which the signs and symptoms pointed to spinal concussion. I was able to investigate a case which pointed to spinal commotion rather than concussion. I am indebted to my late assistant, Captain Moodie, R.A.M.C., for the following notes and material.

Private A——, 16th Middlesex. Died July 8, 1916. This man was badly wounded on July 1, 1916, during the early advance on the Somme. There was a superficial graze probably caused by shrapnel or a fragment of shell over the spine of the left scapula and a small in-and-out wound over the right gluteal region. This wound was about two inches long and superficial. It was clean, and the muscles were not involved. He had had tetanus antitoxin (quantity unknown). His

mental condition was fairly clear, although somewhat marked by his halting speech and extreme somnolence. He was, of course, much fatigued, and had suffered from lack of food. He had complete paralysis of the legs and abdominal muscles and the left side of the face. There was marked loss of power in both arms. There was a complete anæsthesia from the level of the umbilicus downwards, atony of the bladder with overflow incontinence and loss of control of the rectum.

The pulse varied between 80 and 90 per minute, but was of weak tension; there was no albumin in the urine. He merely became weaker and eventually coma preceded death on July 8, 1916, without additional symptoms having presented themselves. Post mortem: Complete examination was made and nothing to account for death was found.

WILLIAM MOODIE,
Captain R.A.M.C.,
O.C. 17 Mobile Laboratory.

Microscopic Examination of Portions of the Spinal Cord

A portion of the spinal cord extending from the eighth dorsal to the fourth lumbar segment was sent to me for examination by my former assistant, Captain Moodie. The material arrived in good condition in formol solution. Portions were blocked in paraffin, and sections of five microns were cut and stained by van Gieson, Nissl, and Leishman stains; the last named yielded the best results.

The eighth, tenth, twelfth dorsal, first and second lumbar segments were examined; similar appearances, although the changes varied in intensity and degree, were observed in all the sections. Briefly they were as follows: On the surface of the spinal cord blood corpuscles were seen adhering—evidence that the cerebro-spinal fluid had contained blood during life. The veins upon the surface of the spinal cord were everywhere congested; the arteries and capillaries as a rule were empty. In places the *veins* could be seen *ruptured*, and in some sections *intraradicular hæmorrhage* was observed. In the substance of the spinal cord itself were numerous minute hæmorrhages, varying

in size from a pin's head, and visible to the naked eye, to a pin's point, invisible except by aid of the microscope.

The hæmorrhages are seen especially in situations where the surrounding tissue offers least support; consequently they are found in the grey matter of the anterior horns, but especially at the base of the posterior horn near the central canal (*vide* Fig. 29).

Frequently small veins are observable both in the grey and white matter which have ruptured, and numbers of

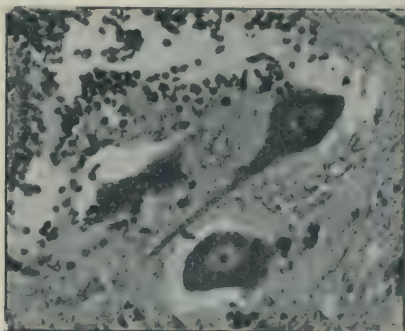


FIG. 28.—Medium-sized anterior horn cells in first lumbar segment; a microscopic hæmorrhage is seen near; the Nissl granules have almost disappeared in the cells, and the staining is diffused and uniform without the displacement of the nucleus. Magnification 330.

the escaped red corpuscles are seen in the perivascular sheath.

There are distinct changes in the anterior cornual cells of varying intensity. There is perivascular chromatolysis, and not infrequently there is some swelling of the cell and eccentrically placed nucleus (*vide* Fig. 30). These changes do not seem to bear a direct relationship to the hæmorrhages; it is probable that the finding of these wide-spread capillary and venous ruptures with blood extravasation is important in showing the violence of the commotion to which the delicate fibrils, forming the neuronie synapses in the grey matter, have been subjected. Mechanical compression by the escaped blood corpuscles probably plays only a minor

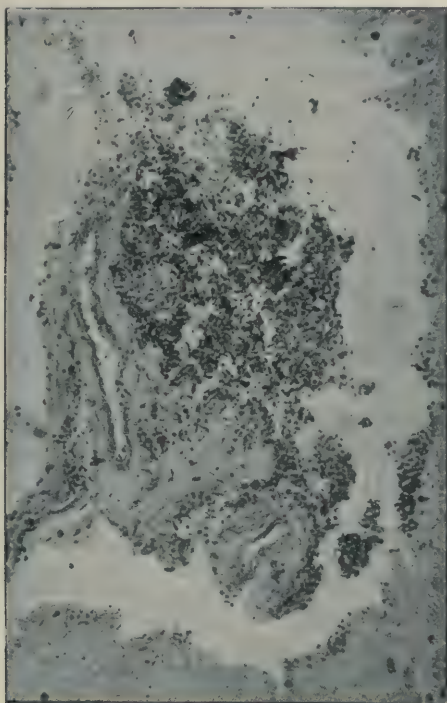


FIG. 29.—Hæmorrhage, the size of a small pin's head, at the base of the posterior horn; the tissues around are fractured and retracted, but this may be in part due to the action of the fixing fluid. Magnification 185.

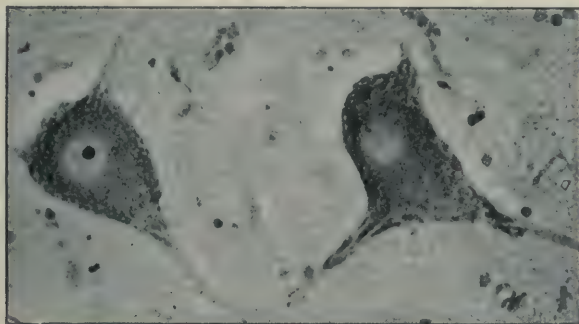


FIG. 30.—Two large anterior cornual cells from the third lumbar segment showing fairly well marked perivascular chromatolysis; the nucleus in one is eccentric and the nucleolus cannot be seen. Magnification 360.

part in producing the loss of function. Had an examination of the cervical cord, of the bulb, and of the pons been made, no doubt similar changes would have been found to account for the symptoms noted. The anæsthesia below the level of the umbilicus likewise may be accounted for by the damage to the grey matter especially noted at the base of the posterior horns.

We do not know what happened to this man, but the shrapnel wounds and the condition of paraplegia, together with the histological microscopic findings in the spinal cord, strongly support the view that a large shell burst near by, wounding him and causing spinal commotion but without injury of the spine. He may have been blown up in the air and thrown violently on the ground, but this seems unlikely, as the notes state that his mental condition was unimpaired and there was no visible injury of the spine; consequently the most plausible explanation of the cause of the pathological condition of the spinal cord is *commotion*. No cause for death could be found except shock.

Very probably had the rest of the nervous system been examined I should have found a condition of things similar to the other cases of shell shock that became comatose and died, viz. marked congestion of the veins, subpial hæmorrhages, ruptured vessels with collapsed and empty arterioles, capillaries and venules associated with dilatation of the perivascular sheaths and chromatolytic changes of the ganglion cells indicative of exhaustion. But I have found this same condition of vessels and ganglion cells in a patient that became comatose and died of shock caused by very extensive burns. It seems probable that emotional shock produces sudden loss of consciousness by its effect upon the vaso-motor nervous system causing sudden lowering of blood pressure and cortical anæmia. But emotional shock may be followed by more or less permanent effects, and especially when combined with the

physical effects of shell shock the vaso-motor derangement may persist and the patient may become comatose and die. If this does not happen the patient may show on recovery of consciousness various signs of cortical anæmia with its attendant neuronie exhaustion and dissociation, viz. headache, dizziness, tremors, delirium, amnesia, inability to concentrate, mental confusion, automatic wandering, and so on.

Opinions of French and German Neurologists regarding Shell Shock by Windage

Many discussions have taken place by French and German neurologists regarding the question of organic changes occurring in the central nervous system as a result of *vent du projectile* or windage. According to Léri, a true commotion appears only to be produced at a proximal distance of some ten metres from great projectiles. The finding of groups of men dead in the last attitude of life, in closed spaces such as the German concrete dug-outs, and the proven fact that enormous forces of compression and decompression are generated by the detonation of high explosives in great shells, aerial torpedoes, and mines have lent support to the view that mere proximity to the explosion is sufficient to cause organic changes in the brain and spinal cord by the atmospheric compression and decompression; altogether apart from actual concussion caused by violent contact with solid materials, such as sandbags or the earth forming the walls of a dug-out, which may at the same time cause burial or partial burial, unattended by visible evidence of injury of the body sufficient to account for symptoms of cerebral or spinal concussion. The patient is rendered unconscious and his mind is a blank concerning what happened in a true case of "commotio cerebri"; consequently he is unable to say whether he had or had not been concussed

by the sand or earth. In the two cases under consideration there was no history of burial.

Undoubtedly the vast majority of non-fatal cases of shell shock are more emotional in origin than commotional, and occur especially in subjects of an inborn neurotic or neuropathic temperament; but the two conditions may be associated. Both Léri and Meige emphasize the fact that commotional symptoms are not influenced by psychotherapy. They also point to the fact that in cases where organic changes have occurred the cerebro-spinal fluid withdrawn by lumbar puncture exhibits macroscopic or microscopic evidence of blood indicating that hæmorrhage had occurred.

In Case I Captain Stokes noted at the post-mortem examination that the fluid was blood-stained, and the microscopic findings of ruptured vessels explain this.

Léri states that the subjects of commotion are generally depressed, asthenic, aboulie, and often more or less confused mentally; they present almost constantly, even in light cases, pronounced disturbances of voltaic vertigo. They often suffer with bleeding from the ear, or nasal or vesical hæmorrhage. Roussy and l'Hermitte admit that in rare cases *vent du projectile* may cause organic changes.

Robert Bing gives a review of the German opinions upon nervous accidents determined by the near explosion of a projectile. He points out that Vogt and Gaupp, who have occupied themselves with *Granat Kontusion* (bomb contusion), are far from accepting the exclusive psychogenic rôle in the development of this syndrome. Gaupp insists particularly upon the relations which exist between the initial symptoms presented by those patients and the rapid succession of atmospheric compression and decompression which takes place at the moment of the bursting of the projectile. The existence of labyrinthine lesions, almost regular in this class of case, is in support of this opinion (Schultze and Meyer).

In von Sarbo's numerous publications upon the subject there is a tendency to regard these cases from a uniform point of view. For him the general mass of observations do not permit the diagnosis of organic changes in the usual sense of the word, nor that of psycho-neurosis. He believes microstructural alterations occur, but they are not equivalent to the molecular changes of Charcot. He includes in the microstructural changes meningeal oedema, microscopic hæmorrhages, transitory paralysis of vessel walls, and contusion of the nuclei and centres. In the initial period these lesions may give rise to some discrete symptoms of organic disease; later they are manifested by functional physical and psychical symptoms. Bing remarks that the pseudo-neurasthenia of arteriosclerosis supports this view. It is interesting to note that the hæmorrhages into the perivascular sheaths of vessels observed in Case I resemble in some respects those seen in arteriosclerosis.

Oppenheim's view of traumatic neuroses had few supporters at the Congress at Munich.

Aschaffenburg examined soldiers in Flanders who had been exposed to shell fire in the trenches but had escaped unwounded and were apparently well. The examination took place in most cases within twenty-four hours after leaving the trenches. Of seventy-four men so examined, sixty-seven showed unmistakable signs of localised organic lesions of the nervous system, although not as a rule of a serious nature. A second examination a week later showed that some, but not all, of these phenomena had disappeared. Here were cases, therefore, in which an organic basis was present but no traumatic neuroses had developed. Aschaffenburg gives the result of his experience in these words:—

“In assuming organic change as one of the consequences of shell explosion I do not thereby agree with Oppenheim that the nervous symptoms are to be attributed to these changes. On the contrary, it is to be noted that the most

exaggerated hysterical cases which develop after exposure to shell firing are the ones which exhibit organic symptoms least of all."

Experiments upon Animals

Bearing upon this question of commotion I will refer to an interesting article by A. Mairet and G. Durante, on the "Commotional Syndrome," which was published in the *Presse Médicale*, June 15, 1917. They have experimented upon rabbits by means of powerful explosives in order to try and find out what happens to soldiers in the trenches.

A charge of melinite or chédite placed at 1.50 metres, then at 1 metre, was successively raised from 125 grammes to 1 kilogramme. Of twelve animals used five died spontaneously, respectively in five minutes, one hour, one day, eight days and thirteen days after. The others, after a momentary unconsciousness with acceleration of respiration and temporary excitement, sometimes rapidly recovered and were killed, with the result that no signs of local lesions were present. Histological examination in all the animals that died showed early lesions consisting of more or less extensive islands of pulmonary apoplexy, caused by rupture of alveolar capillaries. In most cases hæmorrhages and suffusions of blood were found on the surface of the spinal cord, in the roots between their emergence from the cord and at their conjugation; also limited ruptures of small vessels in the grey matter of the cortex and of the bulb, causing a blood effusion into the perivascular lymphatic sheath.

More rarely perivascular suffusion of the radiate vessels of the medulla oblongata and of small vessels behind the endyma was observed. The nerve cells were healthy. Vascular changes were found in the anterior horn and spinal ganglia only in two rabbits, and hæmorrhages in the kidney were found in one animal.

The hæmorrhages especially occur from vessels which are badly supported by surrounding tissues, the blood then escapes into the perivascular lymph sheath which does not offer any support. The hæmorrhages are minute, and are diffused, and this fact speaks in favour of a sudden rupture of the wall caused by the decompression which suddenly follows on the wave of compression.

These changes observed by Mairét and Durante are very similar to those which I have described in the cases examined. Professor Marinesco has examined material obtained from animals exposed by Major Crile to the forces generated by the detonation of high explosives, and has observed similar changes to those above described.

It will be noted that in Case I there was pulmonary hæmorrhage found at the autopsy.

The Effects of Windage (Vent du Projectile) upon the Eye and Ear

The majority of the cases of blindness resulting from individuals being in the proximity of an explosion of a shell are due to emotional rather than commotional shock. But cases have been recorded of changes in the fundus following shell shock, and a brief reference will now be made to these.

In opening a discussion at the Ophthalmological Society, Ormond stated that few war lesions are of greater interest than those cases that have been collectively termed concussion blindness; that is, a condition in which a soldier is rendered unconscious by proximity to the explosion of shells, bombs, aërial torpedoes, and other projectiles charged with high explosives, and when he regains consciousness finds that he is unable to see. Definite organic injuries may or may not be sustained by the eye.

A major in the artillery was sent to me for blindness in the left eye; he gave the following history: He was in

a dug-out and a shell came through the roof and buried him. He was unconscious for three days. When he recovered consciousness, on June 8th, he was blind; he had some trivial wounds of the head and a good deal of blood came from the left ear. On July 1st he recovered sight in his right eye, but two months later he was still blind in the left eye; even a bright light appeared "as a brown blanket." There was blepharospasm of this eye, and sometimes the eye was quite closed. The hearing was perfect. The fundi were normal. There was no evidence of any atrophy, therefore no evidence of hæmorrhage around the nerve, which might have been suspected from the fact of his statement that blood came from the ear. The pupils reacted normally, and Mr. Treacher Collins, who saw the case for me, confirmed my opinion that it was functional.

Captain Ormond, at a discussion held at the Ophthalmological Society, described eleven cases out of eighty with lesions which he attributed to "windage," but Captain Cruise, although he was ready to admit that cases might occur, doubted whether such a high percentage as Captain Ormond's could be regarded as reliable.

Mr. Treacher Collins has described the case of a soldier who suffered from rupture of the choroid, attributed to the explosion of a shell near him. Also Mr. A. L. Whitehead said that a short time previously he had seen a case of "commotio retinæ" within an hour of the accident.

The general consensus of opinion was that *vent du projectile* may produce retinal and choroidal lesions, but the instances are rare, and we can never be certain that there was no physical concussion in some of the cases that were not seen soon after the injury occurred; for, as a rule, the man by losing consciousness and by virtue of an anterograde and retrograde amnesia is unable to tell what happened.

Emil Grosz affirms that "detachment of the retina or

rupture of the choroid may occur in cases in which the bullet passes at a relatively considerable distance."

In cases of explosion, the air pressure alone may be responsible for such lesions as choroidal rupture or opacity of the lens; cataracts due to this cause resorb spontaneously.

Kinneir Wilson, in discussing the subject of Concussion Injuries of the Visual Apparatus, was of the opinion that "certain symptoms usually held to be functional in type may be the expression of a direct visual concussion, undoubtedly an organic condition. These symptoms are concentric constriction of the visual fields, and the occurrence of helicoid or spiral fields with certain tests."

Mairie and Chaletin have described two cases where the visual fields were constricted. In these two cases there was a grave trauma of the occipital region, followed by cortical blindness. They regarded the general blindness as due either to commotion or compression. In each case the blindness persisted and was followed by macular vision. Wilson remarks that the restricted fields are clinically indistinguishable from the fields met with in hysteria.

Lister and Holmes describe a case in which there was limitation of the fields. Major Hurst in a letter to *The Lancet*, November 17th, 1917, is convinced that both narrow and spiral fields of vision are invariably the result of unconscious suggestion on the part of the observer.

For the present, it appears to be a reasonable contention that, in certain cases without permanent visual defect of the accepted organic type of hemianopia or scotoma, contracture of the fields and helicoid or spiral fields may be the expression of an organic change, the basis of which is a violent "commotio cerebri," or a concussion amounting to contusion of the visual cortex or some part of it, not more closely to be specified, or of the subcortical visual projection system.

The Ear

The cases of "windage" affecting the delicate structures of the eye are rare; the same cannot be said of the ear, for deafness of one or both ears and vestibular symptoms are of frequent occurrence. Rupture of the tympanum and hæmorrhage into the middle ear are not at all uncommon. It may, however, be noted that a good many cases of deafness are due to wax damped against the tympanum, to blocking of the Eustachian tube, and, in numbers of instances, the deafness has been due to aggravation of pre-existing middle and internal ear disease. I have seen a case of shell shock in which the hæmorrhage into the middle ear was associated with and may have caused peripheral facial nerve paralysis.

Capt. Gordon Wilson's results and observations are of great interest in respect to the relative frequency of ear affection. Of two hundred cases exhibiting nerve symptoms ascribed to the forces generated by high explosives, which he saw at the 3rd Canadian Casualty Clearing Station, and at the 3rd Canadian Stationary Hospital—fifty complained of deafness of varying degree. Of these fifty, seventeen showed demonstrable signs of injury to the internal ear traceable to the explosive forces; that is, 8.5 per cent. Of the remaining thirty-three, deafness had been temporary and no objective signs of disturbance of equilibrium were observable. The persistent defect of hearing was due in some to chronic middle-ear inflammation, in others to blocking by wax of the auditory meatus or to some other cause.

Of the seventeen cases, seven had symptoms of nerve deafness without perforation of the tympanic membrane; ten had deafness with signs of recent perforation; six had definite middle-ear trouble previous to the concussion; of the other eleven with no previous history of ear trouble, six had recent perforation; twelve complained of vertigo and

had observable signs due to it; the others had complaints or symptoms pointing to disturbances of equilibrium.

From these observations, and also from an extensive experience at the West Cliff Canadian Eye and Ear Hospital in which he had under observation a hundred cases of injury to the internal ear and its central connections from high explosives, Capt. Gordon Wilson has formulated the following conclusions upon the effects of high explosives on the ear:—

1. Exposure to high explosives may produce rupture of the membrana tympani. This rupture may occur at any part of the membrana. It varies in size, and two perforations are occasionally seen. Small perforations are most frequent, but there may be a large perforation, and in one of these the malleus was driven back.

2. The rupture in the membrana tympani tends, in most cases, to spontaneous closure. Its non-closure is usually due to its large size, or middle-ear suppuration following the rupture. Appropriate treatment hastens healing and diminishes the risk of suppuration. Adhesion of the malleus to the internal wall of the middle ear is frequent.

3. Concussion of the internal ear with nerve deafness and equilibrium disturbances occurs with or without rupture. In many cases the concussion passes off with slight damage to hearing, though equilibrium disturbances may persist for a considerable period.

4. The concussion may pass off leaving an injured nerve mechanism demonstrable by: (a) nerve deafness of a varying degree; (b) defect of equilibrium.

5. The treatment of recent perforated membrane which gives most satisfactory results aims at leaving the blood clot over the perforation intact. The following has been found satisfactory: A plug of cotton is placed in the meatus and the lobe of the ear is cleaned and dried. The plug is removed, and then the outer part of the external meatus is cleaned by pledgets of cotton dipped in hydrogen peroxide. The meatus is then dried and washed with pledgets dipped in alcohol and again dried. A piece of sterile cotton is then placed in the ear.

6. All the cases ought to be kept in bed for at least ten days to allow effects of the concussion to subside.

7. The detonation of high explosives may cause a definite

injury to the ear and its central connections. The diagnosis requires considerable experience. A considerable proportion of the cases seen with deafness following exposure to high explosives had no sure definite trauma demonstrable, and the deafness present was accounted for by some other cause. Speedy recognition of those so injured by high explosives, with treatment, means more rapid recovery of hearing, diminution of the subjective symptoms of vertigo, so apt to persist, and subsequent usefulness. In view of these facts an otologist of experience ought to be available at appropriate centres.

8. Apart from such injuries, there were frequently seen cases of deafness or ear disease in which removal to the base was unnecessary, *e.g.*, wax in the ear, furunculosis in the canal or slight serous discharge from old perforations; and cases where delay in treatment involved in transportation to the base has aggravated the disease and delayed the recovery, *e.g.*, acute middle-ear disease. In such cases an otologist ought to be available.

Voltaic Vertigo

The French lay stress upon the frequency with which disturbances of voltaic vertigo occur as a result of commotion provoked by the forces generated by the detonation of explosives without causing visible injury; it is really labyrinthine shock. Henri Français diagnosed cerebral commotion by explosion in cases where there was no external injury, but subjective sensations, together with hypertension and hyperalbuminosis of the cerebro-spinal fluid. Two electrodes of two centimetres diameter are employed, and one is placed on each mastoid.

In the normal state the head inclines to the side of the anode with three to five milliamperes. In the patients so examined suffering with commotion, the head is inclined towards the same side, whether the positive or the negative pole be applied to either mastoid. According to Léri it requires fifteen milliamperes to cause vertigo in cases of shell shock. According to Français, voltaic vertigo demonstrates in the subject of commotion the existence

of vestibular disturbances in a great number of cases. In those cases where voltaic vertigo is normal and no objective symptoms can be found, commotion may be regarded as deprived of grave symptoms and the patients can be returned to their depots after a short rest. Out of thirty-two patients thus diagnosed and examined twenty-five showed disturbances of voltaic vertigo. Français further considers that focal encephalic lesions may arise, and he describes a case of hemiplegia in a non-syphilitic subject of shell shock, with all the signs of Babinski present. There was no cardiac disease.

Jacob made an examination of voltaic vertigo in 115 subjects; he gives the following table of comparative results of trephined and commotional cases.

	<i>Trephined Cases.</i>				<i>Commotion.</i>			
Normal Vertigo	10	.	.	.	2	.	.	.
Pure Resistance	13	.	.	.	8	.	.	.
Abnormal Formula	29	.	.	.	13	.	.	.
Without Resistance
Abnormal with resistance	25	.	.	.	14	.	.	.

Another method which he employed of testing labyrinthine excitation was to make the subject take a stick in his two hands and with head bent down turn round three times, firstly in the same direction as the movement of the hands of a watch, then three times in the opposite direction. There is a positive excitation of the left labyrinth, a tendency to fall towards the right in the former, and in the latter there is a positive excitation of the right labyrinth and a tendency to fall to the left in the normal state.

¹ Capt. Golla, from a series of interesting experiments with the rotating chair on spatial perception, formulates the conclusion that in vertigo there is consciousness of displacement of the ordinary balance between the vestibular sensation and the muscular sense. It was when there was a discrepancy between the two sensations that one became conscious of something being wrong with the position of the head. When there was a destructive lesion of the vestibule the person behaved in a different way; he was unbalanced, and his sensations were different from what they would be were both vestibules acting.

Consecutive Mental Phenomena of Shock

Temporary irresponsibility: A man who is suffering from shell shock may become maniacal and suffer with delusions or hallucinations, causing him to be dangerous to himself or his comrades; he may suffer with mental depression and become suicidal. He may be dazed and behave like an automaton and wander away from his post. This is not an infrequent cause of a court martial for desertion.

Case of Temporary Irresponsible Action.

November 16th, 1917.—The patient denies that there are any neuropathic tendencies in his family.

He is 49 years of age, attended school from 5 to 13 years old, reaching the 4th Standard. He had no serious illness. After school he worked in a wool factory for one year and then took up wood working. He is now a wood turner, averaging earnings over £2 per week. He is married and has six living children and four dead. He has been temperate regarding alcohol, averaging about two glasses per week.

He joined March 25th, 1915, and went to France January 1916. On the 18th July he was struck on the forehead with a piece of shrapnel, was knocked about six feet and unconscious for three hours. He was sent to England, and for one year was in and out of hospitals, complaining of paroxysmal headaches of variable duration from a few hours to several days. He is quite positive that there were no convulsive attacks. He returned to France June or July 1917 and was assigned to a Labour Battalion, where he was exposed to shell fire. A German 'plane came over dropping bombs, and the patient says he lost his head. He challenged an officer and threatened to shoot him, and later was discovered pointing a rifle at an officer. He was confined to his quarters, and the patient was surprised the next day when told of what he had done. He returned to England about October 15th, 1917, and for two weeks was at Eastleigh and a fortnight at the Maudsley.

Now he has no headaches and there have been no convulsive attacks. He keeps to himself and does not associate much with the other men, but works about the ward and reads the newspapers. He has a fair idea of the progress of the war, but seems to have a poor memory, as shown by the difficulty he has in recalling the birthdays of his children. He is clear about

present time, gives the day and date correctly, although he has not acquired the names of people here. Physically he has exaggerated knee-jerks, slight tremor of the hands, but the tongue and eyelids are steady. There is general loss of muscular strength, he tires easily and does not feel cheerful. The X-ray plates show nothing abnormal.

The officer's account of the assault is to the effect that the patient challenged him at night with a loaded rifle and without learning his identity apologised. Later the officer was told by a bombardier that he found the patient taking aim at this officer, who was standing at the door of his tent.

It is the officer's opinion that the patient had a delusion that he was to patrol the camp and look for spies.

Mental Confusion with Hallucinatory Delirium

Mental confusion with hallucinatory delirium (day-dreams) is not an uncommon sequel of "shock," which may be due not only to "commotion," but to an even greater degree to "emotion." In this condition the patient not only suffers with terrifying dreams at night, but he has terrifying day-dreams of the terrible experiences and sights he has witnessed (*vide* pp. 126, 127); he may be deaf, aphonic, mute, or both deaf and mute. "There is no art to find the mind's complexion in the face," even if he cannot speak, for the expression denotes horror or great anxiety; there is motor agitation, sometimes a convulsive crisis occurs, and tremors are always present. His speech, if he is able to speak, is usually either tremulous, hesitant, syllabic or stammering. He has occasionally suicidal and homicidal impulses owing to hallucinations, as shown by the following case.

Shell Shock: Retrograde and Anterograde Amnesia, recollecting only the Noise and Flash of the Explosion; Wandering; Seizures of Intense Fright, as if he had Terrifying Hallucinations inciting him to defend himself by asking and feeling for his Revolver.

Lieut. G—— recollects nothing that happened in the past, not even going to France, nor the Colonel, nor the places he was

stationed at, but by looking at a map he recognised that it was Albert. He does not recollect being admitted to the hospital at Le Treport, but recovered his senses there, and he recollects everything since.

When he was admitted to hospital he stated that he had a recollection of a great noise and a vivid flash. He sees blood during the day. He has terrifying dreams of the whole roof bursting in on him. The other night he said he felt he wished to kill another man in the room.

He remembered that he had a thrashing at school, but of where the school was he has no recollection.

He still complains of headache, made worse by attempts to remember. He says that he had trench boots on when he was admitted to the C.C.S., and also that there was mud on his hair.

After admission to the Maudsley hospital, a patrol found him wandering and said that he was quite natural in his manner, but he could not remember what his name was. He refused to go to bed when brought back, but we put him to bed. He was continually asking and feeling for his revolver. He was not drunk nor was he violent, but he had, from time to time, seizures of intense fright, and he glared about him feeling at the same time for his revolver, shouting out, "Here they come, boys; shoot the devils." He also saw again in his imagination a scene in the C.C.S., that no doubt he had witnessed, for he mentioned the name of a corporal in the R.A.M.C., and said, "Don't let his head fall, if you do he will die." These terrifying day-dreams lasted for some time and were associated with homicidal tendencies.

Mental Confusion and Hebetude

After a variable period of unconsciousness following "shock" the soldier may recover. If he is not dumb it will be found that his mind is in a state of confusion; there is both anterograde and retrograde amnesia. He has little or no idea of time or place, and his powers of recognition and comprehension are greatly impaired. He may be deaf or mute or a deaf-mute; it may be difficult therefore to ascertain what his mental condition is by conversation; or, unlike simple pithiatric mutism, he may be unable to write. The condition of his mind is reflected, however,

in his face, for he has a dazed, stupid, mask-like, mindless expression. He probably assumes an anergic, crouched or curled-up posture, but he may wander about in an automatic-like way.

In all these conditions consecutive to commotional shock there is severe headache and vertigo; the deep reflexes are exaggerated, and in some cases there are signs of hyperthyroidism, rapid action of the heart, hyperidrosis and acro-cyanosis.

The "shock," not necessarily commotional, may cause such an effect upon consciousness that for days, weeks or months the patient may remain in a state of anergic stupor; there is a complete emotional indifference, not unlike some cases of dementia præcox. The patient sits in a crouched attitude indifferent to his surroundings, or lies in bed curled up and makes no response to questions; the expression is mindless, the hands cold, blue and sweating, the pulse feeble; only the vegetative centres of his brain seem to be working normally. He can be fed and swallows the food given him. He may for a time be indifferent to the calls of nature. Later he may be roused with difficulty, and when he begins to recover, speech may be limited to a few words. His replies to questions denote a deep degree of amnesia; possibly he can only utter a few inarticulate sounds or words. The speech may be tremulous, hesitant, staccato, or there may be perseveration of words and syllables. All the outward mental manifestations of the patient, his attitude and expression, his language and his conduct are those of a child. There is, in fact, a mental regression to the stage of early childhood. This condition may be regarded as an alteration of the personality characterised by a state of amnesic delirium founded upon a basis of mental confusion. I have seen four cases in which both the words uttered and the sentences framed resembled those of an infant; *e. g.*, one patient, a Canadian, who made a complete recovery, when

asked how he did to-day for some time replied, "Me bettah," the tone and modulation of the voice being quite infantile. Another case was that of a New Zealander, who, when sat up to be fed, scrambled forward with both his hands like a dog when digging a hole. We afterwards learnt that this man had been buried for some time, and I came to the conclusion that this was a perseveration of a purposive movement connected with the instinct of self-preservation. When these cases recover consciousness they often complain of terrifying dreams of horrifying experiences witnessed prior to the shock; sometimes they dream of the sound and flash of the exploding shells. The facial expression denotes anxiety, fear, and sometimes horror. The cases I am about to relate no doubt were psychogenic as well as commotional in origin. Probably the former factor was the more important of the two.

Shell Shock followed by Condition of Complete Amnesia, Mask-like and Mindless Expression and Infantile Vocabulary and Mode of Utterance.

Personal History.—His associates say that he was a "decent chap," a teetotaler and non-smoker before he joined up. He began to smoke while in the army. He started to keep a diary and called it an account of his journey and health in France. From this diary it is learned that he joined the army in June 1916 and arrived in France on October 12th and went into the trenches in October.

October 30th, 1916.—He refers to the bombardment and says his nerves suffered a severe shaking and that he had headache. He was in the trenches only 28 hours and complained of rheumatism and reported sick. He was in hospitals from November 21st, 1916, to May 19th, 1917, when he again went to France. After rejoining his regiment they were in rest quarters and moving until July 4th, 1917, when he left for the trenches.

The medical record shows that he was in a "nose" trench and was blown up on July 5th, after having been in the trenches part of two days.

Attitude and Manner.—The attitude is distinctly childlike. He stands in an uncertain attitude, feet slightly spread, body bent forward slightly, head on one side and arms hanging limply. He is bashful and self-conscious and reaches for the nurse,

much as a child looks for his mother. The facial expression is blank and the lines of expression are smoothed. He is not apathetic or "shut in," and is distinctly in contact with his environment. He notices children's voices in the street outside, and is amused by a passing street piano. He is distinctly curious about what happens.

He comes when called, but does not obey commands to open mouth, close eyes, show tongue, and give hand. When addressed in simple language ("Soldier, show tongue") he can imitate the motion made by the examiner. He does not dress himself, he eats with his fingers, although clean in his habits. When he wants to go to the rear he asks for the key by making a motion as unlocking a door. He spends much time playing with picture cards and roughly blocking with coloured pencils the outlines of animals and flowers. He copies letters beginning where one ordinarily finishes, but the result is fairly good. In copying London he makes the letters all except the *o*'s, for which he leaves spaces. He cannot be induced to attempt the *o*'s. He holds the pencil as a table knife is usually held. He has special places for his various articles, and keeps certain pictures apart from others. Emotionally he is curious and interested and not at all apathetic. He plays with pictures and papers, moving them about and handling them, and looks longingly at his wife's picture. He occasionally cries when looking at his wife's picture and traces her face with a forefinger.

His vocabulary is limited to the words "me," "man," "soldier," "dallas," and "yes." He does not name a knife, pencil or penny, but says "yes," when asked to name them. When shown a group of photographs containing nurses and patients he was asked if a nurse was "man." He said "yes," to all of the women, but called the men soldiers. He had a small basket with pin-cushions representing apple, plum, and strawberry, but does not point to the article when asked to do so.

November 24th, 1917.—About two weeks after this was written the patient was visited by his wife. He showed a decided change in his condition shortly after. His facial expression was better and he became more interested. Now he is quite natural in his demeanour, associates freely with the other patients, converses freely and no longer acts like a child. He says that he can remember nothing about the period between July 4th and his wife's visit, does not recall the winter or his admission to the hospital. He recalls perfectly everything that takes place about him now, is correctly orientated and remembers trivial incidents of yesterday. He has slight

tremor of hands, tongue and eyelids, but no disorder of gait or weakness of the arms. He dreams nearly every night and awakes with a start. He reads and can write, but does not sing, whereas before his sickness he was quite fond of singing.

Shock in Relation to Loss of Memory

AMNESIA MAY BE CONFOUNDED WITH UNCONSCIOUSNESS

Before the introduction of the Army Form W. 3436 a very great difficulty in the complete investigation of cases of shell shock arose from the fact that few or no notes, as a general rule, accompanied the patients; one had therefore to rely upon the statements made by the patient himself, or perchance of a comrade, if he had no recollection of the events that happened. Those cases of shell shock, however, which were able to give satisfactory information of the events that preceded the shock (to tell you even that they could call to mind the sound of the shell coming, and see it, in the mind's eye, before it exploded), followed by a blank in the memory of variable duration, are in all probability not commotional, but emotional in origin. In the more severe cases, especially where there has been burial or physical concussion by a stone or a sandbag, or by falling heavily on the ground after being blown up in the air, there is a more or less complete retrograde amnesia of variable length of time. In a case of simple shell shock it is impossible to say whether the patient was unconscious during the whole period of time of which he has lost all recollection of the events that happened, or whether during the whole or a part of the time he was conscious, but, owing to the "*commotio cerebri*," the chain of perceptual experiences was not fixed. In the majority of cases shell shock affects only the higher cortical centres; in severe cases the vital centres, as in apoplexy, alone continue to function, or the patient is only in a dazed condition, and he may automatically perform complex

sensori-motor purposive actions of which he has no recollection whatever. Several cases of this kind have come under my notice, but I will describe only one of the most reliable, as it is a history obtained from an officer :—

His company had dug themselves in in a wood; he went out into the road to see if a convoy was coming, when a large shell burst near him. It was about two o'clock in the morning and quite dark; about 4.30 a.m. it was quite light, and he found himself being helped off a horse by two women who came out of a farm-house. He had no recollection of anything that happened between the bursting of the shell and this incident. It is interesting to note that it is possible for him to have inhaled noxious gases, for the single cigarette in a metal case that was in his breast pocket was yellow on one side, due, no doubt, to picric acid contained in the explosive.

All degrees of effects on consciousness may be met with, from a slight temporary disturbance to complete unconsciousness with stertorous breathing continuing till death.

The following is another case of amnesia which was complicated by choreiform movements.

A young lieutenant was admitted under my care suffering with acute chorea. There was no rheumatic history; he had a bruise over the left forehead; he complained of terrifying dreams. He remembered nothing that happened between his arrival at Havre and his return to consciousness at the hospital in Boulogne except a vague notion of arms and legs flying in the air, of which he frequently dreamed. I ascertained that he had been at Hill 60, battle of Neuve Chapelle, and had been blown up by a shell and suffered with concussion. His brother had received a letter from him telling him that he was moving to the front, but he had no recollection of having written this letter. He could recall nothing that happened after his arrival at Havre. Reading the newspaper, he saw the word Bailleul; he said he was familiar with the name as a place he had been at, but it was merely a word association, for he had no recollection of the place nor of anything that happened there. Some of the terrifying dreams this patient had were based upon incongruous association of past experiences. Thus he was troubled especially by this dream: He and his company were charging up an inclined plane; when they arrived at the top a

gigantic Prussian sat down and swept them all back. The inclined plane was associated with the fact that he had seen a battleship launched prior to going to France. After playing billiards he dreamt that Prussians were pelting him with red-hot billiard balls. The terrifying dreams in this case persisted for months. But the only recollection he has of experiences during the period of anterograde and retrograde amnesia was of arms and legs flying in the air, of which he has a vague recollection.

Memory and Recollection

Memory is the storing away of perceptual experiences out of consciousness, and recollection is reviving by will and association the images of those experiences in consciousness. Some of these patients after they have recovered from the shock and are convalescent are able to revive in consciousness the events which happened. A great psychic feature of "commotio cerebri" from shell shock is the resulting inability of the brain to exercise sustained attention on account of the mental fatigue which occurs, and rest is imposed by the feeling of weariness and various forms of headache or discomfort. Again, irresolution and indecision are a frequent result of shell shock, whether induced suddenly or after prolonged exposure to shell fire and the stress of trench warfare. This is a serious disability in officers and non-commissioned officers placed in positions of responsibility. The condition is often associated with loss of recollection of recent happenings, and this disability is a constant source of anxiety to the officer who is conscious of the possibility of his failure to execute orders.

Shell Shock: no History accompanying this; provisionally diagnosed Cerebro-spinal Meningitis. Sent to England; marked Amnesia, signs of Hyperthyroidism. Return of Memory and Account of being blown up by a Shell. Gradual subsidence of all Symptoms.

Private P— L—, admitted to Maudsley Hospital October 19th, 1917. Went to France April 1917.

October 20th, 1917.—Expression that of fear and dementia. Dilated pupils; isthmus of thyroid enlarged; v. Graefe sign; tremor of eyelids when closed; tremor of hands; jerks of legs and back. Inco-ordination in arms and legs—more so in legs. Epigastric, cremasteric and plantar reflexes normal. Knee-jerks exaggerated. Holds neck stiff with head slightly backward, but can bend it forward. Kernig's sign not obtained. Very nervous and easily frightened, and cries. A provisional diagnosis of cerebro-spinal meningitis had been made. There was, however, no rash and the cerebro-spinal fluid exhibited no evidence of meningitis by microscopic examination; nor could meningococci be cultivated.

He is better to-day and states that he was fighting at Ypres, where he was shelled on the 31st July "in the push." He says that he was gassed once, but still "carried on." He described the gas (which was tear-gas) as smelling like pineapple.

After recovering from shell shock he returned to the line. This time he heard the shells, but did not see the one that affected him, and did not know anything until he found himself in a hospital (*vide* Fig. 31).

October 24th.—He feels better, but last night he was awakened by the orderly when he was dreaming. He was afraid he was going to die. His heart felt queer and he could not breathe. He felt that he could not move or help himself.

His memory is poor as to recent and past events, and he is unable to do a simple sum. He cries when talking of his wife.

November 1st, 1917.—Blood-pressure, recumbent 116 systolic, 85 diastolic; pulse rate 96. Pulse pressure is low (31), and the sound is weak, difficult to determine the diastolic change; the throw of needle of instrument is also slightly less than normal. A suggestion of a positive Babinski of both sides (though probably negative). No Kernig sign or stiff neck. Pupils react slightly to light and accommodation, equally dilated. Von Graefe, Moebius, Stellwag signs positive. No anæsthesia made out, but general hyperæsthesia. Heart sounds weak; apex beat not obtainable by palpation, and very weak sounds upon auscultation.

Better, sleeps fairly well. Less forgotten and altogether less appearance of fear. Albumin in urine, no casts.

November 29th, 1917.—He now remembers more of the experiences from the time he went out to France until he was shelled. When he was in the trench, the parapet was partly knocked down and he was partly buried by a shell which exploded twelve feet from him. He lost consciousness at the time of the explosion. He remembers nothing more until he came to the hospital.



FIG. 31.



FIG. 32.



FIG. 33.

Physical examination.—Still well-marked von Graefe sign. Convergence poor. Pupils dilated. Thyroid palpable. Pulse 80 per minute. Moderate coarse tremor of tongue and fingers. Much better. Has headaches. Dreams about the war; sees the Germans coming up with their helmets and grey uniforms. He thinks much of war experiences during waking hours; always rather nervous (*vide* Fig. 32).

November 29th, 1917.—The patient has not improved beyond a certain point, although he is now much better than on admission. He is being invalided.

December 30th, 1917.—This patient has made a most extraordinary recovery. He is still very feeble in mind and body, but will probably still further improve with hospital treatment and should be kept in on that account.

He was discharged at the end of January (*vide* Fig. 33). The three photographs show his condition at successive periods.

Periodic Amnesia

Lapses of memory lasting hours or days may occur in soldiers who have suffered with shell shock months or even years after it happened. Men who are in hospital or who have been discharged from hospital are subject to these lapses. Sometimes they are brought to the hospital by the police, who have found them wandering, unable to give any information which would lead to their identification. To take a typical case. A soldier, who had a gold stripe on his tunic showing that he had suffered with a battle casualty, was brought by the police to the hospital; he could neither recollect his name nor his regiment; he did not know where he had come from nor where he was going to. He could comprehend and obey simple commands. He did not understand his own name when written down. He had a dazed appearance and exhibited the usual signs of hyperthyroidism. We subsequently found that he had suffered with severe shell shock. These lapses of memory are psychogenic, and are apt to be attended with serious consequences. I have not met with cases which have been dangerous to themselves or others, as sometimes happens in the automatism of epileptics. A

sufferer with periodic amnesia is, however, liable to be taken up by the police and placed in the lunatic ward of an infirmary, if he has been discharged from the army; or if he has taken a little alcohol he might be charged with being drunk.

Psychogenic amnesia may arise from other causes than "*commotio cerebri*," as the following case shows. In fact, when we speak of shell shock causing periodic amnesia, it must be borne in mind that other factors, such as emotional shock, acquired emotivity, and especially a neuropathic predisposition, may be followed by periodic lapses of memory.

An officer with distinguished service was brought into the 4th London General Hospital by the police on January 7, 1918. I saw him the next day; there was a great deal of mental confusion, he did not realise where he was, nor could he give any connected account of himself. His orientation in time and space was very deficient. There was no head wound or sign of injury. The next day he was able to give the following account of himself.

In April 1917, trench fever; sent to Rest Station, Camoens, after two weeks returned to first line. On August 19th-20th, after the Lens attack and as a result of prolonged insomnia, he had two attacks of unconsciousness, lasting about four hours and eight hours respectively. No warning. He was by himself, and therefore does not know what happened. On November 8th, after Paeschendale, he was evacuated again with trench fever; he could not use his legs and had great pain at the back of his head, also difficulty in retaining water. Anglo-American Hospital at Vimereux, one week. Plymouth: remained there about four weeks; recovered use of legs, but had pain in head and insomnia; no bad dreams. December 13th he applied to return to Canada, and his request was granted. He was discharged upon three weeks' furlough; went to Lincolnshire and reported at the H.Q.M.B. January 4th he was instructed to report at Whitley. On the 7th he reported at once by letter, and received permission from C.O. to report to him on 7th or 8th, without kit. On Monday, 7th, he remembers inquiring about trains at Waterloo; from thence

onwards to admission to the 4th London General Hospital his memory is a blank. His mother suffers with neurasthenia. Father is eighty. He has four brothers and two sisters, who have no evidence of nervous or mental affection. Two brothers have been killed in France. He has no recollection of anything that happened during those three periods of amnesia.

Another case was that of a man who had signs of contusions on the head resulting presumably from an accident, but his memory was a blank from the time he had left his friends to the next day after his admission to the hospital.

Musical Memory in Relation to Shell Shock

The musical memory usually returns earlier than other forms of memory. An interesting example is afforded by the following case.

Private G—— was admitted under my care; his mind was a complete blank, and his condition was reflected in a dazed, mindless, mask-like expression. When asked where he lived, he said, "W——"; he did not know that it was in the West Riding. He did not know the address of his home, and when shown a letter from his father with the address on the top he did not recognise it or his father's handwriting. When shown a photograph of his home with a group of his father, mother, and three brothers and himself in front of it, he maintained the same wondering, dazed expression, and failed to recognise the nature of the picture. His father had heard from a comrade that he had been buried by the explosion of a shell in the trench; he had been unconscious for some time and had lost his speech. We heard from his father that he was a good musician, and I said to him, "G——, I hear you are a good musician," and I asked him if he could play the piano or sing; there was the same wondering, bewildered look, and he muttered something which was to the effect that he could not sing or play. Three days later I said, "Come, you can whistle 'God Save the King.' " He took no notice, but upon pressing him, he looked up, a glint appeared in his eyes, and he said, "You start me." I whistled the first bar, he took it up, and whistled it admirably. I then asked him to whistle "Tipperary," but he could not do it till I started him, and the same with several other tunes, but once started he had no

difficulty, and I recognised from the admirable intonation that he was, as his father described him, an excellent musician. I could not, however, that day get him to start upon his own initiative any one of the tunes he had whistled. The next visit, three days later, I observed that his expression had changed. He smiled when I spoke to him, and I recognised clear evidence of a mind that had partly found itself. He could now whistle any of the tunes I had previously started him on by himself, when I called for the tunes. I then said, "Come along to the piano." He came, and I got him to sit down in front of it. I said, "Play." He looked at the instrument with a blank expression, as if he had never seen such a thing before, and I could not get him even to put his fingers on the keys. I then took one of his hands, and, holding his forefinger, I made him play the melody of "Tipperary." He looked at me, and again I noticed a glint in the eye and a change of his blank expression indicative of reminiscent association. He put his other hand on the keys and played a few chords. I went away feeling confident that his musical talent would reveal itself. He played for half an hour while I was in the ward without a single discord. The next time I came he was able to play any music set before him. His associative memory and recollection of music was in advance of other associative memories. Thus, eight months after he had recovered his musical memory, he had very imperfectly recovered his memory of elementary facts regarding his profession of a land surveyor—*e. g.*, he could not tell me how many poles there were to a rood—and there was still a tendency to a vacant mindless expression and prolonged reaction time, as shown by delay and slowness in responding to questions as if there were a difficulty in linking up the necessary associations.

This early return of the musical memory happened also in another severe case of amnesia, which I will briefly relate.

This patient was admitted for shell shock. He had almost a complete loss of recollection of all the incidents of his past life except some experiences of early life, such as where he went to school. His powers of recognition were limited to knowing his parents. He had a bewildered vacant expression and a slow reaction to questions; when interrogated his countenance assumed a puzzled aspect as of one trying to recollect. His memory for recent events was absent, and persons whom he had frequently or daily seen he failed to recognise. After

four months he had made but little improvement. His memory of the past seemed to show the first signs of awakening in the associations of music. He recollected musicians that he had heard and songs that he had sung, although, as in the above case, he remembered nothing of his professional occupation. He said that while with his friends he had been asked to sing songs which they said he had sung before—that he did not recognise them at all when he saw them, that after they had been played to him two or three times he was afraid to begin, as he felt he did not know them, but that, once he started, “he seemed to know without remembering” and got through quite well. One song he managed after it had been played through only once (“I Hear You Calling Me”). I learnt from an officer who had been a school-fellow of this patient that he had suffered with a head injury in early life. This may have produced a *locus minoris resistentiæ* in his brain.

Every state of consciousness which is habitually repeated leaves an organic impression on the brain, by virtue of which that same state may be reproduced more readily at any future time in response to a suggestion fitted to excite it. But it may be asked, Why should the memory of music be more readily revived in consciousness than other experiences?—for example, those connected with the professions of these two young men before they entered the army. I should explain it by the fact that there can be no doubt that cognitions, whether pleasurable or painful, are more deeply graven on the mind and more firmly fixed in associative memory when associated with intense feeling. Music, of all the arts, appeals most to the emotions, and probably this is the reason why countless men and women, even the uneducated, can recall the words of songs and hymns when they hear the first bar of the musical setting.

Fixation and organisation of repeated experiences in the mind is shown in music, for a song that has been sung a number of times only requires the first word or note for it to be continued to the finish without any effort of consciousness, the last note or word uttered serving as the appropriate stimulus of the next; as in an instinct we

have what is termed a chain reflex. This was strikingly exemplified in a soldier under my care who suffered with motor asphasia and right hemiplegia in consequence of a bullet wound of the brain.

The bullet entered the left side of the head and passed through the left fronto-central region of the brain and through the right orbit, destroying the eye; in its passage also it must have cut through the left optic nerve or tract, for he was totally blind. This poor fellow was very cheerful and comprehended all that was said to him; thus, by feeling my tunic sleeve he recognised my rank, for when asked if I was a captain he expressed negation by "oot," colonel also by "oot," meaning "no," and major by "ah." He obeyed all commands. Now, curiously enough, although he was able to express judgments only by "ah" and "oot," which correspond to Yes and No, he was able to sing several songs through without difficulty provided the first word or bar of music was given. Thus, I stood beside him and hummed "'Tis a long way," and immediately he started the well-known chorus of "Tipperary," winding up with "Are we downhearted?—No!" I then said, "Say Tipperary, Tom." He replied, "Oot," and he was unable to utter any of the words. It must be concluded either that the song had been repeated so often as to have become organised in both halves of the brain or in subcortical lower centres. We know also that in amnesia rhymes are recalled very easily, especially if they have been learnt in early life. A month later, when I saw him, he was able to walk and speak. Thus, given a half-crown, he felt it, then tried the rim for milling on his teeth, and said, "Two shilling bit." When asked again, he corrected it with "Half-crown." Given a penny, he tested it in the same way, and the unpleasant taste left in his mouth caused him to throw it down with all the signs of disgust, saying at the same time "Copper."

Hysterical Speech Defects

Various forms of speech defects are common; they are mutism, aphonia, stammering, stuttering, and verbal repetition. The most frequent speech defect is mutism. About one in twenty of those admitted with a history of shock due to high explosives, and having no visible signs of

injury, suffer with mutism, but are, nevertheless, quite able, as a general rule, to write a lucid account of their experiences. Most of the men so afflicted are unable to whisper or produce any audible sound; thus there is no sound when they laugh. They are unable to whistle or to cough, and in severe cases there is difficulty in putting out the tongue, and, in one case, of swallowing. The pharyngeal reflex is lost. Whereas mutism is common among soldiers and non-commissioned officers, it is comparatively very rare in officers. Stammering, stuttering and verbal repetition is not infrequently met with in officers, and in many of these the history shows that they had these speech defects in early life or in pre-war times; in some it was merely an exaggeration of a previous similar speech defect. The following two very severe cases of shell shock with mutism, which occurred in May 1915, may be cited, for two reasons: first, owing to the severity and persistence of the symptoms, I thought the case was not wholly hysterical, but due in part to commotional effects on the central nervous system; second, in the light of further experience, I felt confident these cases were hysterical, and could have been cured in the early stages by physio-psyche therapy.

“Severe Shell Shock” without Visible Injury except Wound of Wrist, Unconscious Three Days, terrifying Experiences and Dreams, marked Aspect of Terror, Mutism, Weakness and Inco-ordination of Upper Limbs, inability to masticate or swallow at first, persistent loss of Power in Legs with Anæsthesia and Analgesia. No Babinski Sign. Intelligence and Silent Thought unimpaired. Later, recovered Movement in Upper Limbs, and able to write. Complete Recovery after Eleven Months, except Sensation and Movement in Legs.

Private W—, admitted to 4th London General, May 15th, 1915. This patient is speechless; he is lying in bed almost helpless. The eyes are wide open and have a pained, vacant stare, the brow is lined by many deep transverse furrows, and both the pyramidales and the corrugatores supercilii are strongly contracted, so that at the root of the nose vertical

furrows meet the transverse folds of the forehead, caused by the contracted occipito-frontalis muscle. The nostrils are somewhat dilated, and the mouth partially open, the nasolabial furrow and the other lines of the countenance are for the most part obliterated, so that the expression is like to that of intense terror. The face is flushed and perspiring. The hands are blue and cold, and the pulse at the wrist is hardly perceptible. The feet are cold. He is unable to sit up by himself; he cannot protrude the tongue beyond the teeth, although he made an effort to do so, and there were slight movements of his lip, as though he were attempting to articulate. He comprehends all that is said to him, and tries to make himself understood. He cannot masticate because he cannot open his jaw; he has difficulty in swallowing, and at first there was considerable difficulty in giving him nutriment. Later, he was able to swallow jelly, lightly boiled egg and mince. He replies to questions by affirmative or negative nods of his head. He can read written and printed language, but when given a paper and pencil to write, so great was his difficulty in holding the pencil, and so pronounced was the tremor, that the pencil only marked a tangled skein on the paper, although it was evident that he was making an attempt to write. He cannot move his legs, which are rigid, and the right is decidedly more wasted than the left. There is patellar clonus and ankle clonus, but the plantar response was rather flexor than extensor. He has complete control over his sphincters. When I saw him a few days later he was better and playing draughts with another patient. He could not take the pieces up, but managed to push them on to the squares. This patient was able to converse with him by the deaf and dumb manual. He said he had learnt this sixteen days prior to admission. We also ascertained that his memory only goes back to the time he landed in England, but he had been told that two months previously a shell had burst near him and rendered him unconscious for three days; a fragment of it had also caused a wound on the wrist, a scar of which still existed. He had previously seen a sergeant and seven others killed by a shell. He had not had tetanus. He suffers with terrifying dreams. He is very intelligent. He can neither cough nor whistle nor blow out the cheeks.

At first there was a frequent tendency to regurgitate fluid or to vomit it. His swallowing has improved, likewise his circulation, but now, ten days after admission, he has difficulty in swallowing; he cannot bend his legs, put out his tongue, or open his mouth, raise himself in bed, or turn without assistance.

June 1st.—Steady improvement in his circulation, respiration, and power of swallowing soft food. Still quite unable to move his legs. The transverse furrowing of his brow much less evident. He still dreams.

June 7th.—Tested his sensibility with a needle; for the most part he does not respond at all to pricking; occasionally he indicated that he felt, once on the inner side of the right thigh, once on the inner side of calf of right leg. He was told to nod, and hold up his left or right hand, according to the side stimulated. He responded once on the left side of abdomen, but when he did respond there was *marked delay*. He did not feel the head of pin, at least no response was obtained; nor did he feel the vibrating tuning-fork on his limbs, although he responded with marked delay when put on his ribs or his forehead. But the vibration had to be of large amplitude. Tested with large tubes containing hot water and ice, he did not respond to the former, but he recognised the latter as cold, although there was considerable delay. A succession of sharp pricks in the same place on the limbs produced no response to stimulus. He now smiles or even laughs, but there is no sound accompanying the expansion of his features. He still is unable to blow or whistle or phonate, although he understands everything; he cannot write. There is marked spasticity of the lower limbs. The patellar reflex can just be obtained; there is no clonus. Ankle clonus, not typical, is present. Plantar reflex: the only response is a slight flexor flicker of the little toes. The superficial abdominal reflex is just obtainable.

Respiration is less shallow; abdominal movements are observable, indicating descent and ascent of diaphragm of the normal quiet breathing of the male.

He readily becomes fatigued; when he attempts to use his hands there is marked weakness and inco-ordination. None of the muscles, however, appear wasted. Captain Clayton tried strong faradic stimulation to the larynx, but without any resulting phonation.

August 2nd.—Patient sat up; for the first time was helped to stand on his feet by two persons, one on each side, supporting him under the shoulder. When tested with tuning-fork, there was a marked delay—ten seconds on the hands before he gave an affirmative nod, whereas, placed on the forehead, he responded immediately. The pharyngeal reflex is absent. He can now blow out a candle at a distance of a foot. There is no real tone in the cough. Never any difficulty with his sphincters.

October 18th.—He cannot feel below the knees. *He can now write quite well*; sitting on the wheel chair, he plays billiards

and even Badminton. He is very happy, but cannot speak, whisper, or whistle. He is able to stand, supported on both sides, but cannot raise his foot from the ground, though he has tried hard to do so.

December 26th.—Said "Paddy" once, and with great exertion managed to stand, but he cannot raise a foot from the ground. There is anæsthesia and analgesia of the legs as high as the knee. The muscles are not wasted.

March 12th.—He now speaks quite well. His speech returned in the following manner. He was sitting in his wheeled chair playing baseball, at which he was quite good, when a runner overturned him; the sudden emotional shock and surprise made him exclaim aloud, and since then he has quite recovered speech. But he cannot walk; there is still the stocking anæsthesia as high as the knee. He was consequently boarded out.

"Severe Shell Shock": Blown into the Air in Trench; does not remember falling; Aspect of Terror, Mutism and inability to phonate or to expire forcibly. Sudden Recovery of Speech Eight Months later.

Private F—— H——, age 20, admitted June 1st, 1915.

Appearance.—Face flushed, eyes staring wide, pupils dilated, forehead wrinkled, mouth partially open, all the lines in the naso-labial fold obliterated. Hands and feet cold and blue.

Pulse very small and feeble, hardly perceptible on left, just perceptible on right.

He comprehends what is said to him, and tries to put out his tongue, but it hardly comes beyond the teeth. The lips move slightly in attempts to speak. He can read, and answers quite rationally and intelligently by writing.

When asked how he was knocked out, he wrote: "There was something dropped into the trench. I think it was a shell; I felt myself go up into the air, but I cannot remember falling. The next thing I remember I was in a farm with some doctors. I don't know how long a time there was between. I have not had any dreams."

He cannot whistle, he cannot cough, and cannot take a deep breath. The diaphragm, examined by X-rays, showed only slight movement of tranquil breathing, though he was told to cough.

He remained in this condition for a few days; his pulse and general condition improved.

He was transferred after three months to Morden Hall. He was told that he had adenoids, and that an operation would

not only get rid of this trouble, but he could then speak. He had the operation performed under an anæsthetic, but on recovery he did not speak. The suggestion had no effect. He was often depressed at finding others regain their speech, and he, unable. He was a good fellow, and tried to get well. His joy was great when he recovered his speech, which returned quite suddenly. He was in a punt and it was turned over, and he was capsized into the water, which made him shout out. Practically he was mute for more than eight months. He often shouted words in his sleep about trench warfare, so he must have had dreams but forgot them.

Why should these mutes, whose silent thoughts are perfect, be unable to speak? They comprehend all that is said to them unless they are deaf; but it is quite clear that in these cases their internal language is unaffected, for they are able to express their thoughts and judgments perfectly well by writing, even if they are deaf. The mutism is therefore not due to an intellectual defect, nor is it due to volitional inhibition of language in silent thought. Hearing, the primary incitation to vocalisation and speech, is usually unaffected, yet they are unable to speak; they cannot even whisper, cough, whistle, or laugh aloud. Many who are unable to speak voluntarily yet call out in their dreams expressions they have used in trench warfare and battle. Sometimes this is followed by return of speech, but more often not. The sudden and varied manner in which these mutes recover their power of articulate speech and phonation is indicative of a refractory condition of the voluntary cortical mechanism of phonation. In some cases there is a history of a blow on the chest—*e. g.*, from a sandbag—or of being buried and partially asphyxiated, and it is usual for the loss of speech to occur at the time of the shock. One patient, however, gave a history of difficult speech for two days after the shock; he lost his speech completely only after his vestibular reactions had been tested; while another, who after the same investigation became a deaf mute,

recovered his speech upon hearing a man in the hospital say the word "Rose." He at once sat up and repeated the word, proving, as he said, "I could both speak and hear." Some of the earlier and more severe cases of shock followed by mutism were unable to expire forcibly enough to cough, to whistle, or to blow out a candle, but the less severe may be able to perform these acts and yet be unable to speak or whisper. The latter cases recover usually more quickly than the former, but sudden recovery may occur even in the severe cases. Thus a private who went to France October 1914, on August 9, 1915, was going to pick up a wounded comrade when a shell came and blew the wounded man to pieces, and he knew no more till about half an hour later, when he found himself deaf and dumb. There evidently were two factors in the production of the symptoms—the physical and the psychical—and of the two the latter was the greater. This patient was admitted under my care. Some weeks later his fellow soldiers thought he ought to hear and speak, and they adopted energetic measures to make him shout out for help. Two of them leathered him with a slipper and then nearly throttled him. He struggled and shouted, "Stop it." Another man dreamt he was falling over a cliff, shouted out, and recovered his speech. Another dreamt he was blown up by a trench mortar and shouted for help. Finding himself speaking, he continued to speak aloud, and did not go to sleep again for fear he might lose his speech. Another man, a deaf mute, was heard to speak in his sleep. He was told by a comrade. He said, "I don't believe it." Some have suddenly recovered their speech by crying out when unexpectedly feeling physical or mental pain; for example, one man cried out when some boiling tea was spilt over him, another when he was held down and his feet tickled. In most cases it is the sudden and unexpected which restores the function of the vocal mechanism. Thus a mute sergeant

saw some soldiers larking in a punt and he suddenly shouted out, "You will be over." Occasionally the stimulus of a well-known chorus has broken down the refractory condition in the psychic mechanism of the voice, and the mute has surprised himself and others by finding himself singing. The recovery of speech may in some cases be only whispered speech—that is, aphonia supervenes. In other cases mutism is followed by stammering or stuttering. Such cases are often found on inquiry to have stammered, stuttered, or suffered with a hesitant speech at some time in their life prior to the shock. In many cases such a speech defect seems to have definitely originated as a result of the shock. I have recently seen a number of cases of hysterical aphonia and mutism occurring in soldiers who have been suffering with the effects of mustard gas. The aphonia and mutism can be cured by galvano-psychotherapy, but the voice frequently remains hoarse on account of the laryngitis, and by auto-suggestion relapses are frequent. This mutism of soldiers in no way differs from the pre-war description of hysterical mutism given by Bastian: "Some of the leading peculiarities of hysterical mutism are these. Its onset is very sudden, and often after a fright or some strong emotional disturbance. Sometimes it follows an hysterical seizure, either with or without paralysis of limbs. At other times it occurs without assignable cause, or it may be induced, as already stated, in some hypnotised persons by suggestion. The subjects of this disability are completely mute, presenting in this latter respect a notable contrast to ordinary aphasics, who so frequently make use of recurring utterances or articulate sounds of some kind. The intellect seems unimpaired, and they are able freely to express their thoughts by writing." Though the common movements of the lips, tongue, and palate are preserved, these parts (constituting the oral mechanism) are unable to act in the particular combinations needful for speech

movements, in association with the other combinations of muscular action pertaining to the vocal mechanism.

Bastian notes also that there may be more or less complete anæsthesia of the pharynx in hysterical mutism; this I have observed in some of the mutes. He notes that, as in these soldier mutes, hysterics may recover their speech suddenly as a result of a strong emotion, also as in the soldiers, recovery may be followed by stammering or stuttering.

Bastian refers to a case in which frequently recurring attacks of mutism were generally associated with blindness or deafness, one or both. These conditions are also observed associated with mutism in soldiers, the subjects of shell shock. He also cites a case of his own: a sailor suffered with a great number of attacks of mutism (the first occurring as a result of fright) but previously he had not suffered from any nervous disease, but had led an active life in all parts of the world. We may therefore conclude that this mutism resulting after shell shock in no way differs from hysterical mutism. It appears, therefore, that there is nothing new in these functional disturbances and disabilities of speech and special senses, except it be their severity and frequency in men the subject of shell shock.

Pathogenesis of Mutism

We may now inquire into the pathogenesis of mutism. Charcot attempted to draw a distinction between aphonia and mutism. He adopted the doctrine of Marey and other physiologists that the larynx takes no part in whispered sounds. According to Charcot, therefore, aphonia (in which the power of whispering is preserved) is a result of a partial paralysis of the adductor muscles of the larynx; while as to hysterical mutism Charcot writes: "If the individual suffering from the affection is unable

to whisper, it is not because he is aphonic, or rather because his vocal cords do not vibrate; it is not because he has lost the common movements of tongue and lips—you have seen that this patient was able to blow and whistle; it is because he lacks the ability to execute the proper specialised movements necessary for the articulation of words. In other terms he is deprived of the motor representations necessary for the calling into play of articulate speech.” Charcot therefore believed the oral division of the speech mechanism only to be at fault in hysterical mutism. Wyllie maintains that, whilst this may be so in some cases, in a second group it is the laryngeal division of the speech mechanism which is at fault, and in a third set of cases both oral and laryngeal mechanisms are simultaneously disabled. Charcot considered hysterical mutism to be an instance of pure “motor aphasia” resulting from a functional trouble in Broca’s region. Bastian, however, agrees with Wyllie that aphonia and mutism are most intimately related, differing in degrees only, “and the oral and vocal speech mechanisms are concerned in all speech mechanisms whether sonorous or whispered.” Bastian considers that the clinical differences between simple aphasia and hysterical mutism force us to believe in the existence of a bilateral cortical disability in the third inferior frontal convolution.

Sir Charles Bell, in his great work on the Expression of the Emotions, first drew attention to the influence which powerful emotions exercise upon the respiration. A part of the cortex controls the mechanism of breathing in the production of all voluntary audible sounds, and this, like the movements of the vocal cords, is represented in both halves of the brain, for the muscles of the two sides of the body which control the breath and phonation always act synergically and never work independently. In the oral division of speech mechanism the muscles of one side never act independently of the other. Bastian is probably,

therefore, correct in asserting that it is a functional disability of cortical structures in both hemispheres. Whether he is right in asserting that it may be localised in the third inferior frontal is another matter. I believe this mutism is due to the persistence of a fear-reaction inhibiting the voluntary cortical nervous centres which control phonation, for we have seen that mutes during sleep, owing no doubt to the excitation of dreams, may cry out and utter articulate sounds. Many cases cannot produce any audible sound, for they are not only unable to talk or whisper, but to whistle, to utter a cry or to laugh aloud. I examined one case by means of X-rays and found the diaphragm could by no effort of the will be made to descend in a way sufficient so to fill the lungs as to produce an adequate expiratory blast for coughing. He acquired this power later and was able to take a fairly deep inspiration, but he could not talk, whisper, or whistle; even instinctive audible sounds such as a cough, a cry, or a sonorous laugh he was unable to produce; the voluntary synergic mechanism of phonation was dissociated or inhibited; the failure was in the cortex, for this mute, like many others, talked and uttered cries in his sleep. The return of tone in the voluntary cough is usually a herald of the return of speech.

But why should the mute be able to express his thoughts in writing but not in verbal speech? Writing, like articulate speech, is acquired by imitation; they are part of the social heritage of mankind; the only human heritage connected with this acquired language is the employment of the left hemisphere by the great majority of human beings as the active partner in controlling the lower motor centres of articulate and graphic expression of internal language, upon which thought, reason, and intelligence depend. But an individual who heard no articulate language would speak no articulate language; still, he could express all the primitive emotions and pas-

sions by gesture, expression of eye and face, accompanied by modulated audible sounds. This primitive language is universal and understood by all mankind. It is the foundation upon which articulate language rests for expressing the emotions and passions. Without modulation of the voice articulate language expresses no more feeling than graphic language. Now the images required for the production of the voluntary impulses necessary for articulate speech by habit are initiated primarily in the auditory and glosso-kinæsthetic centres of the left hemisphere, but the mental images of audible sounds by which the voice is modulated to express the emotions are initiated in an inborn pre-organised mechanism in both hemispheres (see figure).

In support of this may be mentioned the fact noted by Galton in his *History of Twins*, that whereas identical twins seldom showed similarity of character in handwriting, the vocal intonation was usually similar. Again, it is true, as Lucretius observes in *De Rerum Naturæ*, that not only the features but the voice and hair of forefathers are repeated.

Without the mechanism of phonation audible articulate speech, even whispering, is impossible. Two grades of speech defects may be observed in hysteria and as a result of emotional shock—viz. aphonia, in which phonation is extremely weak, and mutism, which is a complete loss of the power of phonation. Laryngoscopic examination shows that the vocal cords are in a position of rest. Experiments on the higher apes show that stimulation of the laryngeal centre produces bilateral movements; there is then bilateral representation of the abductors and adductors of the vocal cords. Likewise there is bilateral representation of the muscles which control the breath in phonation (*vide* Fig. 34).

Consequently we must suppose that mutism is caused by fear producing an emotional shock inhibiting the

activities of the whole of the cortical structures connected

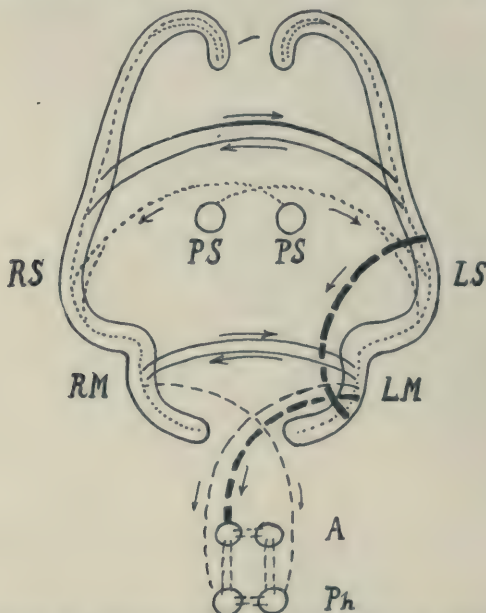


Fig. 34. Diagram to Illustrate the Twofold Mechanism of Articulate Speech.

A represents the lower articulator nervous mechanism; Ph, the lower phonator nervous mechanism; LM, the left motor higher centre of articulation; RM, the right motor higher centre of articulation; LS, the left sensory higher centre of articulation; RS, the right sensory higher centre of articulation; the cortical centres of the speech zone in the two hemispheres are connected by fibres of the corpus callosum indicated by arrows; PS, peripheral auditory nervous mechanism connected with the auditory centre of each hemisphere though mainly with the opposite. It will be observed that the thick interrupted line indicates the *acquired* path of voluntary control over the articulator mechanism in right-handed persons. If this is damaged in early life the right hemisphere becomes the active partner in the production of articulate speech. We are quite conscious of all the movements of the muscles of the tongue, the lips, the jaw, and the soft palate, by which the escape of the breath is modified so as to produce articulate sounds and language. We are conscious only of the pitch and in a measure of the loudness of the voice by the sense of hearing. The production of audible sounds varying in pitch and loudness expresses the emotions; they are voluntarily initiated in both hemispheres and control equally both lower centres of phonation, laryngeal and respiratory.

with phonation and production of audible sounds. Experience has shown that the persistence of the fear-reaction

of inhibition is largely due to the treatment which has been adopted in these cases of hysterical mutism. When soldiers first came over in the early days of the war suffering with mutism and functional paralysis of a severe character such as the two cases recorded they evoked unbounded sympathy and attention. Such cases in males had never been seen before even by neurologists of wide experience, and the idea was pretty general that com-motional shock resulting in organic changes had taken place in the central nervous system. The French neurologists soon learnt that these functional cases are recoverable by electro-therapy and counter-suggestion at the hospitals and clearing stations at the front. For some time past we have also adopted this method of treatment of hysterical cases with marked success.

The Predisposing Factors of War Psycho-neuroses

Quite early in my experience at the neurological section of the 4th London General Hospital I found that the war neuroses and shell-shock cases had (in the majority of instances) an acquired or inborn predisposition of emotivity.

In my Lettsomian Lectures upon "The Effects of High Explosives upon the Central Nervous System," the following statement was made :—

"A large majority of shell-shock cases occur in persons with a nervous temperament, or in persons who were the victims of an acquired, or inherited neuropathy; also a neuro-potentially sound soldier in this trench warfare may, from stress of prolonged active service, acquire a neurasthenic condition. If in a soldier there is an inborn timidity, or neuropathic or psychopathic taint, causing a *locus minoris resistentiæ*, it necessarily follows that he will be less able to withstand the terrifying effects of shell fire and the stress of trench warfare."

I based this conclusion on the following facts of cases

admitted to the Maudsley Hospital Extension during six months :—

- I. History reported on in 156 cases (shock).
- II. No history " " 80 " "
- III. No history of shock in 40 "

- I.—A. History predisposing to shock in 111 cases;
- B. No history predisposing to shock in 45 cases.

Cases.

- A. (a) Nervous predisposition (previous nervous breakdown, timid disposition, neuropathic temperament as revealed by family history, etc.) 52
- (b) Epilepsy (pre-war 20, since war 5). Of the latter one had head injury and two bits of bone removed in 1904, and one developed fits after shrapnel wound of head (frontal) trephined during war 25
- (c) Shock or accident (pre-war) 11
- Traumatic (pre-war) 9
- (d) History of insanity (patient 2, family 7) 9
- (e) Mental defectives 5

Pierre Marie, Nonne, and others have come to similar conclusions.

Gaupp gave expression to a similar view: "In the psycho-physiological make-up of the soldier is to be found a most important cause of neuroses. The psychiatric analysis of the individual cases points to a psychopathic basis in most of the war psycho-neuroses and psychoses, often when the history, as recorded, reveals nothing." Birnbaum in his initial review of the literature on war neuroses and psychoses came to the following conclusion: "Soldiers developing nervous and mental disorders show in the great majority of cases a predisposition (by which is understood not only a congenital, but also an acquired disposition) such as may be observed following the chronic abuse of alcohol, and earlier head injuries with concussion."

Comparative Study of the Personal History of 100 Cases of War Psychosis and 100 Cases of Wounded

At my suggestion and under my direction Captain J. M. Wolfsohn of the American Army Medical Service investigated the personal history and the leading nervous state in 100 of my cases of soldiers suffering with shell shock or war psycho-neuroses (neurasthenia and hysteria), and compared the same with 100 surgical cases suffering with wounds under the care of Captain Turner at the 4th London General Hospital.

The three following tables of the results are quoted from his paper in *The Lancet*, February 3rd, 1918.

TABLE I.—*Family History.*

Percentages of characteristics named in (A) Neurosis,
(B) Wounded.

	(A)	(B)		(A)	(B)
Nervousness	64	15	Tuberculosis — im-	12	4
Alcoholism (parents	50	24	mediate family	6	4
and grandparents)			Tuberculosis — rela-		
Teetotaller (parents	30	16	tives	10	0
and grandparents)			Stigmata		
Irritability of temper	36	12	Positive history for	74	38
Insanity	34	0	one of several of		
Epilepsy	30	0	above		

TABLE II.—*Personal History.*

Percentages of characteristics named in (A) Neurosis,
(B) Wounded.

	(A)	(B)		(A)	(B)
Stigmata	34	4	Enuresis	12	4
Previous nervousness	66	12	Frights in childhood	4	0
Fears	50	8	Excessive religion .	6	0
Head injury	38	12	Positive personal his-	76	12
Epilepsy	8	0	tory		
Tobacco—excessive .	8	4	Positive family and	70	6
Alcohol—excessive .	6	16	personal history		
„ —teetotaller	48	20	Recurrences and re-	14	0
Married	42	28	lapses		
Moody	55	8	Acquired neurosis .	12	3
Previous breakdown	2	0			

TABLE III.—*Present Illness.*

Percentages of conditions named in (A) Neurosis, (B) Wounded.

	(A)	(B)		(A)	(B)
Service	12 mos.	10 mos.	Insomnia	86	0
Unconscious- ness }	55	24	Fears	76	0
Dazed	84	24	Dreams	88	50
Tremor	84	12	Fatigue	94	40
Poor memory	88	4	Headache	88	36
Poor concen- tration }	88	4	Moody	92	0
			Vertigo	74	8
			Fits	10	0

Conclusions

From this study of 100 cases of war psycho-neuroses and 100 cases of somatic injuries produced in the firing-line one can draw the following conclusions:—

Cases of war neurosis are very rarely associated with external or somatic wounds. The vast majority of the psycho-neurotic cases studied were among soldiers who had a neuropathic or psychopathic soil. In 74 per cent. of these cases a family history of neurotic or psychotic stigmata, including insanity, epilepsy, alcoholism, and nervousness, was obtained, whilst a previous neuropathic constitution in the patient himself was present in 72 per cent. Col. Gordon Holmes has written to me to say that a considerable number of the wounded that he has seen suffer with psycho-neuroses. Probably the cases he sees are especially cranial and spinal injuries. Of course we know that these injuries will cause traumatic neuroses. M. Maurice Dide, Chef du Centre Neuro-psychiatrique de la VIII^e Armée, says: "Neuropathic disorders are exceptional in the real wounded; moreover, cases of mental confusion are almost without example in cases of head injury." He does not like the term "mental confusion," but prefers "battle hypnosis," which can be cured in a few days.

A gradual psychic shock from long-continued fear,

together with the sudden change from quiet, peaceful environment to the extraordinary stress and strain of trench fighting, is the chief predisposing cause of war psycho-neurosis in soldiers with neuropathic predisposition. In fact, these factors may be the cause of the neurosis *per se*.

The history of the individual previous to enlistment has an influence on the character and gravity of the symptoms of the neurosis.

It is perfectly certain that among the general population there is a large number of men who are constitutional neuropaths or psychopaths, and in a country where conscription exists the majority of these are recruited. The stress of war, and especially the stress of this war is sufficient to convert a latent tendency to psycho-neuroses or psychoses into a pronounced functional disability. The calling up for military service, the training and the rigorous discipline are sufficient, without active service at the front, to reveal neurotic or psychotic predisposition. This fact was known in Germany before the war, as the following quotation shows—

“The manifestations seen in times of war do *not* differ from those seen in the times of peace.” “For the last fifteen years,” says Stier, “I have been observing cases of *hysteria* in the *army*, and before the outbreak of war I had been able to collect more than 1000 cases. A comparison of my pre-war and recent experience shows that manifestations occurred in *practically the same proportions* in peace time as have appeared since war broke out. *Indeed, we may state that the war has not created anything new in the way of manifestations ; it has merely revealed the fact that amongst a certain percentage of patients, on account of constitutional factors, an exceptionally strong tendency to react in a pathological manner to affective experiences exists.*”

The above-mentioned facts show the importance of studying what a man is born with and what happened after birth when recruiting and subsequently assigning him

to a category for military service. It is not of much use sending a constitutional neuropath or psychopath to the front; he will in all probability break down.

Psycho-neuroses in Recruits and Conscripts

An interesting and instructive report to the Medical Research Committee by Lieut.-Col. F. W. Burton-Fanning upon Neurasthenia in Soldiers of the Home Forces clearly demonstrates the fact that large numbers of men in civil life in all grades of society carrying on their occupations are, when conscripted, the subjects of neurasthenia. Consequently this nervous affection is of great importance from a military point of view as a cause of loss of manpower to the Army. As the author remarks, numbers of these patients have spent far more time in hospitals and convalescent homes than with the units; it is therefore open to doubt whether it is worth while training such men for soldiers, as it would be more profitable to spend the money and energy in the manufacture of munitions.

Another fact which is brought home to all those who have had the care of cases of war psycho-neuroses is, that the signs and symptoms of hysteria and neurasthenia of men who have been to the front and have been invalided home (except those in which there has been definite evidence of cerebral or spinal commotion, burial or gassing) in no way differ essentially from the signs and symptoms of hysteria and neurasthenia of men who have never been out of England. I have seen both hysteria and neurasthenia arise from the fear of conscription, or, having been conscripted, an hysterical crisis has occurred when it became known that the conscript would be in a draft for general service abroad.

Burton-Fanning found that the majority of cases of hysteria and neurasthenia owe their condition to an inborn temperamental neurotic disposition, which accords entirely with my own experience of recruits and of soldiers

suffering from these nervous affections. Indeed, the inborn factor dominates, as a rule, in proportion to the failure to discover adequate cause of stress arising from military service. These conscripts, as Burton-Fanning says, disagree with the doctor's "Fit for Service." "They resent being found fit and bring certificates of their unfitness for which they are willing to pay considerable sums." Such cases give a typical proof of Dejerine's dictum of the essential condition of neurasthenia being a continued emotivity and mental preoccupation which in the recruit's case concerns their unfitness or unwillingness for military service.

In such a mental attitude, therefore, they start their military career under a cloud and find their comrades not over congenial. Many of the men, especially clerks, are quite unfit for hard training and suffer with mental and bodily fatigue, aggravated by insomnia and anxious mental preoccupation. They complain of the usual symptoms of neurasthenia—viz. tremors, fatigability by mental or bodily effort; loss of confidence and irresolution; hyperæsthesia, paræsthesia, and pains which they consider to be rheumatic; fainting attacks; præcordial pain and palpitation; feelings of dizziness; insomnia and dreams; loss of appetite and anorexia; headache and gastric troubles.

The relation of the genital functions to emotivity is well known, and in civil life sexual disorders, sexual abuse, and fears regarding impotence play an important rôle in the genesis of neurasthenia. I have not found a large percentage of officers and men sent home from the front suffering with neurasthenia who have been mentally preoccupied or who have complained of fear connected with the genital functions. In fact, they are few as compared with those seen in civil life. Each individual reacts to emotions according to his personality, and each physical reaction, whether kinetic, cardiac, respiratory, gastric, or genital, when exhibited for the first time, is subconscious.

The Psychology of "Soldiers' Dreams" in Relation to Neurasthenia

Terrifying dreams occur in a large proportion of neurasthenic soldiers from the front, and, inasmuch as their existence is a sign of the continuance of the emotivity, therefore of their unfitness to return to General Service, it will be well to consider at some length the subject of "Soldiers' Dreams" and what they signify, for it will enable us to understand the fundamental principles underlying the causation of war psycho-neuroses, especially neurasthenia, or, as some authorities prefer to term the condition, "anxiety-neurosis." I am in entire agreement with McCurdy, who states: "The best criterion I have been able to discover for permanence of symptoms is the presence of repeated nightmares of actual fighting. I was not able to find a single patient who had once shown these symptoms and subsequently improved without regular and protracted treatment. These remarks refer more particularly to the anxiety states rather than the conversion hysterias."

In books on psychology and psycho-analysis I find little or no reference to the psychology of soldiers' dreams. Yet, in that greatest of all works on human thought and action, we find reference to the dreams of soldiers and their significance, so true to the present-day experiences, that I shall refer to them and the possible classical source of their inspiration.

In the *De Rerum Naturæ* of Lucretius he says—

"And generally, to whatever pursuit a man is closely tied down and strongly attached, on whatever subject we have previously much dwelt, the mind having been put to a more than usual strain in it; during sleep we for the most part fancy that we are engaged in the same; lawyers think that they plead causes and even draw up covenants of sale, generals that they fight and engage in

battle, sailors that they wage and carry on war with the winds. We think that we pursue our task and consign it when discovered to writings in our own native tongue. So all other arts and pursuits are seen for the most part during sleep to occupy and mock the minds of men."

Lucretius next calls attention to the evidence of dreams in animals—

"And often during soft repose the dogs of hunters do yet all at once throw about their legs and suddenly utter cries and repeatedly sniff the air with their nostrils as though they had found and were on the tracks of wild beasts."

In another passage Lucretius says—

"Again the minds of men which pursue great aims under *great emotions* often during sleep pursue and carry on the same in like manner; kings take by storm, are taken, join battle, raise a loud cry as if stabbed on the spot."

In Shakespeare there are two passages which may have had their source of inspiration in the *De Rerum Naturæ* of Lucretius—viz. the speech regarding Queen Mab by Mercutio and that of Lady Percy to Hotspur.

As Lucretius says, a man dreams of whatever pursuit he is closely tied down to; at the present day the soldier dreams that he is in the trenches fighting Germans, or he hears and sees the shells bursting, shouts in his sleep, and wakes with a start. How truly Shakespeare describes this when he says—

"Sometimes she [Queen Mab] driveth o'er a soldier's neck,
And then dreams he of cutting foreign throats,
Of breaches, ambuscadoes, Spanish blades,
Of healths five fathom deep; and then anon
Drums in his ear; at which he starts and wakes,
And, being thus frightened, swears a prayer or two
And sleeps again. . . ."

(In the quarto 1597 the text had "countermines")

instead of "Spanish blades," which seems singularly appropriate just now.)

In Lady Percy's speech to Hotspur there is the following passage—

"Why hast thou lost the fresh blood in thy cheeks;
And given my treasures and my rights of thee
To thick-eyed musing and cursed melancholy? ¹
In thy faint slumbers I by thee have watch'd
And heard thee murmur tales of iron wars:
Speak terms of manage to thy bounding steed,
Cry, 'Courage! to the field!' And then hast talk'd
Of sallies and retires; of trenches, tents;
Of palisades, frontiers, parapets;
Of basilisks, of cannon, culverin;
Of prisoners' ransom and of soldiers slain,
And all the currents of a heady fight.
Thy spirit within thee hath been so at war,
And thus hath so bestirr'd thee in thy sleep,
That beads of sweat have stood upon thy brow,
Like bubbles in a late-disturbed stream;
And in thy face strange motions have appear'd,
Such as we see when men restrain their breath
On some great sudden hest. O! what portents are these?"
(First Part of *Henry IV*, Act II, sc. iii.)

The experiences of the war have shown us how true the psychology of Lucretius and Shakespeare is as regards soldiers' dreams and how utterly wrong the following statement of Brill, a follower of Freud, is—

"Dreams accompanied by fear are of a sexual nature; the ideation causing the fear in the dream was once a wish which was later subjected to repression."

The two fundamental motives to human action are undoubtedly the preservation of the individual and the preservation of the species—that is, self-conservation and propagation.

¹ McCurdy, in discussing the Anxiety Neuroses of Soldiers, says: "The man who is visited by his wife or his sweetheart is a disappointment both to himself and his visitor in that it is impossible for him to give any proof of his affection. This finds expression in a manifestly obvious way through the symptoms of impotence, which is, as far as I have been able to learn, universally present in the anxiety state, either as such, or in the form of its equivalent lack of erotic feeling."—"War Neuroses," *Psychiatric Bulletin of New York*, July 1917.

Soldiers' Dreams and the Doctrine of Freud

Freud, in developing his psychology of the psychoneuroses, found that the dream plays a very important part in the psyche of the individual. The dream, according to Freud, is not a senseless jumble, but a perfect mechanism, and, when analysed, it is found to contain the fulfilment of a wish; it always treats of the inmost thoughts of the personality, and for that reason gives us the best access to the unconscious. "No psychanalysis is complete, nay possible, without the analysis of dreams. The dream not only helps us to interpret symptoms, but is often an invaluable instrument in diagnosis and treatment. The causative factors of many neuroses are extremely vague and usually unconscious to the patients, and it is by means of the dreams that the underlying factors are disclosed."

The doctrine of Freud, and still more that taught by his followers, does not take into consideration, as a psychogenic factor of neuroses, the conflict caused by suppression of painful memories of experiences associated with the emotion of fear in relation to self-conservation.

Capt. W. H. R. Rivers, in a recent interesting article, makes the following statement—

"Not a day of clinical experience passes in which Freud's theory may not be of practical use in diagnosis and treatment. The terrifying dreams, the sudden gusts of depression or restlessness, the cases of altered personality which are among the most characteristic of the present war, receive by far the most natural explanation as the result of war experience which, by some pathological process, often assisted later by conscious activity on the part of the patient, has been either dissociated or is in process of undergoing changes which will lead sooner or later to this result. While the results of warfare provide little experience in the favour of production of the functional

nervous disorders by the activity of repressed sexual complexes, I believe they will afford abundant evidence in favour of the validity of Freud's theory of forgetting."

It will be observed that Rivers accepts the validity of Freud's theory of the Unconscious, but asserts that his experience does not support the pre-war notion of Freud and his adherents that the psycho-neuroses were due in all cases to repressed sexual complexes.

The special merit of Freud's theory is that it provides a psychological theory of dissociation of the factors upon which it depends and of the processes by which its effects can be overcome. According to the views long current in psychology, experience is remembered in so far as it is frequently repeated and according as it is interesting and arouses emotion pleasant or unpleasant, and forgetting is a process which stands in no special need of explanation. The dreams of soldiers, some of which I will relate to you, exhibit in a striking manner how an incident of war associated with emotional shock is graven on the mind, for it continually recurs in a vivid and terrifying manner in their dreams, half-waking state, and in some few cases even in the waking state, constituting hallucinations. Forgetting this painful experience is a natural defensive reaction.

Dreams in Relation to the Unconscious

According to Rivers, Freud's theory affords an explanation of the mechanism of forgetting, and especially the forgetting of an unpleasant experience by a thrusting of it out of consciousness and keeping it out. This mechanism Freud terms the Censor, which is supposed to act as a constant guard, only permitting the arousing of the repressed experiences to reach consciousness in sleep, in the half-waking state, in hypnosis and automatic states in which the normal control of the censor is removed or weakened. Even in such states it is only permitted to

become manifest in an indirect or symbolic manner. But does this hypothetical censor differ essentially from inhibition exercised by the highest centres of control, centres upon which voluntary attention depends? For voluntary attention would be made ineffectual by emotional perturbation. Consequently the inhibitory functions of the higher centres of control must be continually and, after a variable time following the emotional shock, unconsciously exercised in repressing the recollection of the experience. At first during the conscious waking state the experience which caused the emotional shock crosses the threshold of consciousness in spite of the voluntary attempts of the patient to divert the mind, causing mental perturbation accompanied by visible emotional disturbances. The individual is conscious at first of this conflict, but its very continuance tends in the normal individual to make it pass into the unconscious. But this does not mean that the struggle is not going on; for every now and then the painful terrifying experience may in some cases rise into consciousness and cause marked emotional disturbance and depression. I have met with many striking instances of this in officers and men who have returned from the front suffering from neurasthenia.

Dreams in Relation to Neurasthenia of Soldiers

As I have frequently observed, the persistence of terrifying dreams, often of one particular horrible experience recurring with great frequency, and even in the half-waking state persisting in the mind, proves that the struggle is going on. Indeed, experience shows that while these dreams persist the other signs of neurasthenia exist. Indeed, a prognosis of recovery largely depends upon whether the patient has refreshing sleep, undisturbed by these terrifying dreams. We may assume that these dreams cause a state of continuous emotivity.

Indeed, Dejerine points out that the dream can even, in some cases, cause an emotivity if it introduces into consciousness images sufficiently vivid to be considered as an emotive excitation, and when persistent and terrifying as it is in the case of soldiers suffering with war psycho-neuroses, an acquired emotivity may be engendered in a neuro-potentially sound individual.

Emotional and Commotional Shock in Relation to Soldiers' Dreams

In a general way emotion is a reaction of the personality. Under intense emotional shock an individual may be deprived of even elemental perceptions; not seeing any more, not hearing any more, not feeling any more, transformed into a simple automaton, the subject, as Dejerine says, is, so to speak, in a state of psychological syncope. Soldiers under shell fire may become for the time being mere automata, and wander away unconscious of what they have been doing; it is difficult to decide whether they are suffering from emotional shock or from commotional shock without visible injury caused by forces generated by high explosives.

The emotional shock may be the result of terror or horror, and one must differentiate between these two forms of contemplative fear, in both of which the imagination plays an all-important part.

Sir Charles Bell says—

“Horror differs both from fear and terror, although more nearly allied to the last than the first. It is superior to both in this, that it is less imbued with personal alarm. It is more full of sympathy with the sufferings of others than engaged with our own. We are struck with horror even at the spectacle of artificial distress, but it is peculiarly excited by the real danger or pain of another. Horror is full of energy; the body is in the utmost tension, not unnerved by fear.”

Terror is more self-regarding; horror is more altruistic. Both sentiments are based upon the primitive emotion of fear.

The character of the dreams of soldiers shows that they are imbued with terror or horror, sometimes with both.

Secreto-Motor and Vaso-Motor Reactions the Outcome of Suppressed Fear during the Waking State

The subconscious memories of war experiences connected with fear and the self-conservative instinct are probably continually acting upon the lower cerebro-spinal autonomic centres, accounting for many of the secretory and motor phenomena observed in war psycho-neuroses. The motor disorders and disabilities met with in soldiers suffering from emotional or commotional shock are frequently of the nature of instinctive defence reactions. Thus, a tic of the head has acquired the name of the "dodging reflex," being the spontaneous movement which would take place upon hearing a shell coming; this tic is especially liable to be excited by any sudden noise or sound. Again, many of the motor paralyses and disabilities we know to be associated with fear by popular metaphor. Thus, "dumb with fear," "quaking or trembling with fear," "paralysed by fear," and the crouching attitude of many "shell shock" cases suggests the defensive reaction of concealment by immobility—in contradistinction to that by flight or fight. In these latter conditions an increased discharge of muscular energy is required, a rise of blood pressure, and an increased quantity of glycogen is converted into sugar. This is effected through the splanchnic nerves exciting an increased mobilisation of adrenalin from the suprarenal glands.

A very common vaso-motor phenomenon exhibited by soldiers suffering with shock, especially those who are

troubled with terrifying dreams, is acro-cyanosis, cold-blueness of the extremities, hence the popular expression of "blue funk." In about 10 per cent. of severe cases of shock there are signs of Graves's disease—viz. some degree of exophthalmos, von Graefe's sign, Moebius's sign, tachycardia, fine rhythmical tremors 8 or 9 per second, and the thyroid gland is more easily palpable than normal.

Secreto-Motor and Vaso-Motor Reactions the Outcome of Terrifying Dreams

Many of my cases were unable to recollect their dreams, but complained of waking up in a fright and in a cold sweat. Kant¹ explains this by saying that—

"In the waking state we do not remember any of the ideas which we might have had in sound sleep. From this last follows, however, only this much, that the ideas were not clearly represented while we were waking up, but not that they were obscure also while we slept."

Further, he says—

"I rather suppose that ideas in sleep may be clearer and broader than even the clearest in the waking state. For man at such times is not sensible of his body. When he wakes up his body is not associated with the ideas of his sleep, so that it cannot be a means of recalling this former state of thought to consciousness in such a way as to make it appear to belong to one and the same person. A confirmation of my idea of sound sleep is found in the activity of some who walk in their sleep, and who in such a state betray more intelligence than usual, although in waking up they do not remember anything."

In the dreams of soldiers, when the perceptual relations of the body to the external world are dissociated and the inhibitory functions of the highest cortical centres of voluntary attention are in abeyance, ideas of past war

¹ *Dreams of a Spirit Seer.*

experiences are revived with great vividness in the great majority of cases, even in those who are unable to recollect their dreams. For besides those cases which wake up in a fright and cold sweat, there have been numerous instances of soldiers who have walked in their sleep and many others who have talked, shouted out orders and cried out in alarm as if again engaged in battle; some of these have been mutes. But the strangest phenomena of forgotten dreams of soldiers suffering with shock are observed in those who in their sleep act as though they were back in the trenches engaged in battle, and go through all the pantomime of fighting with bomb, with bayonet, with machine-gun and with rifle, and yet remember nothing of these happenings when they awaken. One or two cases of this kind had to sleep in the padded room in order to prevent them doing injury to themselves. Evidently during their sleep vivid imaginings of their previous experiences are arousing defensive and offensive reactions in face of the imaginary enemy.

As these dreams cease to disturb sleep, so these manifestations of fear tend to pass off and give place to the sweet unconscious quiet of the mind. Occasionally during the waking state contemplation of the horrors seen provokes hallucinations or illusions which may lead to motor delirium or insane conduct. At least this is the interpretation I should put upon the symptomatology of the two following illustrative cases:—

1. An officer was admitted under my care in a state of restless motor delirium; he moved continually in the bed, sat up, passing his hand across the forehead as if he were witnessing some horrifying sight, and muttering to himself; yet, when interrogated, he answered quite rationally. This motor delirium I associated with the continuous effects on the conscious and subconscious mind of the terrible experiences he had gone through. His whole company had been destroyed, and, while talking to a brother officer, the latter had half his head blown off by a piece of a shell. The patient improved very much, but

a relapse occurred after a night disturbed by terrifying dreams. Even after a year had elapsed his nervous system showed a marked emotivity and he had to be boarded out of the service.

2. *Paroxysmal Attacks of Maniacal Excitement following Shell Shock*.—A private, aged 19, was admitted suffering with shock due to emotional stress and shell fire. He suffered with terrifying dreams, and after he had been in hospital a short time he developed sudden paroxysmal attacks of maniacal excitement. The first attack occurred suddenly. One afternoon he had been helping as usual in the kitchen, and then he went and lay down on his bed and apparently went to sleep; he suddenly woke with a startled, terrified look, became flushed in the face, sweated profusely, and made for the door as if to get away from some terrifying conditions. He was with difficulty restrained. He remained in this excited state, glaring rapidly from side to side, giving one the impression that he was suffering from terrifying hallucinations of sight and hearing, although he would make no response to interrogation. He did not recognise his wife, the doctor, or the sisters. Once when I, accompanied by two medical officers in uniform (strangers), came up to speak to him he became violently agitated as if some terrifying conditions had been aroused by the sight of the uniforms; the face was flushed and he sweated so profusely that the perspiration dripped in a stream off his nose. The attacks would last from a few hours to a few days; they came on quite suddenly like an epileptic fit and often without any apparent cause. They became more severe and frequent, and when we had moved the neurasthenic patients to the Grove-lane schools he one day ran out of the building into the playground and attempted to get over the wall. He was brought back, and I saw him sitting in the ward on his bed; his head was buried in his hands; I spoke to him; he immediately got up, looked at me in the most terrified manner, and made for the door; it required four orderlies to restrain him, and he fought and kicked violently, exhibiting great strength and nervous energy. Much to my regret I found it necessary to have him sent to Napsbury. I have heard that he has made a complete recovery and has been discharged. It may be mentioned that there was no history obtainable of epilepsy or insanity in the family.

This case rather suggests the psychic equivalents of epilepsy in the attacks.

I have asked numbers of soldiers and officers to write down their recurrent dreams for me, and I possess a

considerable number of such records. Almost without exception they have a direct relation to war experiences. This method avoids suggestion on my part by putting leading questions. I ask them to state how far the dream is related to previous experience and whether any particular dream or dreams constantly recur. I tell them that a correct description in writing will prove a valuable means of throwing off the terrifying effects. In only one instance was there any pronounced sexual basis; the subject of that particular dream, which constantly recurred, was of a disgusting and horrible nature, and when it occurred gave rise to most distressing hysterical manifestations. The patient was a private and wrote down the nature of this dream on condition that I would never make it public. Whether, as he affirmed, he had actually witnessed the scene, or whether, as is possible, it was gross exaggeration, or a delusion arising from a recurrent dream, I am unable to say.

The dreams are nearly always visual and auditory representations, shells exploding which they see and hear, machine-guns firing, etc., and are associated with the emotion of fear; for the patients wake up in a fright and cold sweat.

In one case, however, the patient when just dozing off was disgusted by the smell of dead bodies, and this smell was followed by horrifying visions of putrified corpses. He explained it by the fact that he had been serving some time at the front, and the continuous shell fire had shattered his nerves, rendering him unable to continue to fight in the trenches, and he had latterly been employed in burying the dead.

A very common complaint of soldiers is a falling feeling; this is not limited to men in the R.A.F., although it is usual for them to dream of their especial experiences. A not infrequent dream is that they are engaged in bombing or fighting; that their machine is hit, and that they

are descending in an aeroplane in flames. It does not necessarily mean that this has been their experience, but the anticipation of the possibility of such a catastrophe from the knowledge of the fate of others has left such a deep impression on the mind that the imagination provides the source of the terrifying dream.

A very remarkable dream of an officer of sound nervous constitution is worthy of full consideration, and I will merely record what he wrote, for it clearly shows his dream accords with his experience, and it illustrates how true is the observation of Lucretius—

“And generally to whatever pursuit a man is closely tied down and strongly attached, on whatever subject we have previously much dwelt, the mind having been put to a more than usual strain in it, we for the most part fancy we are engaged in the same.”

This is one instance in which the individual has dreamt the experience of hunger and thirst in addition to battle experience.

Recorded Dream of a Second Lieutenant.

“During the five days spent in the village of Roeux I was continually under our own shell fire and also continually liable to be discovered by the enemy, who was also occupying the village. Each night I attempted to get through his lines without being observed, but failed. On the fourth day my sergeant was killed at my side by a shell. On the fifth day I was rescued by our troops while I was unconscious. During this time I had had nothing to drink or eat, with the exception of about a pint of water.

“At the present time I am subject to dreams in which I hear these shells bursting and whistling through the air. I also continually see my sergeant, both alive and dead, and also my attempts to return are vividly pictured. I sometimes have in my dreams that feeling of intense hunger and thirst which I had in the village. When I awaken I feel as though all strength had left me and am in a cold sweat.

“For a time after awaking I fail to realise where I am, and the surroundings take on the form of the ruins in which I remained hidden for so long.

"Sometimes I do not think that I thoroughly awaken, as I seem to doze off, and there are the conflicting ideas that I am in the hospital, and again that I am in France.

"During the day, if I sit doing nothing in particular and I find myself dozing, my mind seems to immediately begin to fly back to France.

"A dream that keeps on coming up in my mind is one that brings back a motor accident I had about six years ago, which gave me a severe nervous shock. I had, of course, entirely forgotten about it, except when in a motor, when I always thought of it.

"Of the fifth day I have absolutely no recollections."

Effects of the Dream the Next Day

As these dreams are nearly all of a terrifying or horrifying nature, and connected with the emotion of fear and failure of the defensive reactions of self-preservation, the subjects of them awaken with a feeling of dejection and pallor; they have, as Shakespeare says, "Lost their fresh blood in the cheeks."

A dream recorded by one officer is of psychological interest as showing that a dream of a successful struggle for life with an enemy under terrifying circumstances gave rise to a feeling of exhilaration on waking; whereas the same officer's dream of a scene that he witnessed causing horror gave rise to a feeling of dejection.

These two dreams, which recurred at intervals, were based upon two separate experiences. The one related to the existence of the legless body of a Prussian that lay for days in front of their dug-out, and which it was highly dangerous, as it was found to their cost, to remove. The other related to a fight with a Prussian who threw a bomb which just missed the man and exploded out of harm's way; he threw a bomb which blew the enemy's head off just as the Hun was preparing to throw another bomb at him. A repetition of the state of feeling that actually happened during life must be assumed to have occurred as a result of the dream.

ANALYSIS OF DREAMS WITH INCONGRUOUS ASSOCIATIONS
MAY REVEAL AN EMOTIONAL ASSOCIATION

I could multiply instances of memories of particular experiences recurring in soldiers' dreams of a similar character to those related, and I think I have shown that when Shakespeare speaks of dreams born of fantasy, children of an idle brain, he was clearly not referring to the dreams of soldiers who had recently been exposed to all the emotional shock of battle, but to those experiences of past life which had been broken up and dissociated into elemental perceptual parts which are linked up in incongruous association.

Apparently incongruous association may by careful investigation reveal an emotional association; thus a present fear experience may be associated with a past and forgotten fear experience, as the following dream shows :—

An officer who had served in South Africa told me that he had had a dream from which he awoke in a fright. He was in a mine passage at the front when he met a leper who came towards him. Upon questioning him and asking him if he could recall some period of his life in which his mind had been disturbed by a leper, he remembered that in South Africa he and his comrades were much alarmed, and vigorously protested against a leper being allowed to remain in an adjoining sangar. Evidently this had left a deep impression graven on the mind; the principal subject, the leper, was dissociated from concomitant experiences in the South African War, and became linked up with a recent terrifying experience of being in a mine passage, which likely enough was also an experience in which the emotion of fear occurred. Both incidents, suffused with very strong feeling, in all probability were deeply graven on the mind and became firmly fixed by subconscious association.

Another case is the following, in which the dream appeared to have an incongruous association of dissociated experiences, but in which there was a natural association of primitive emotions.

A sergeant, who had been a schoolmaster, was asked to write down his dreams by Captain W. Brown, who had charge of my cases at the Maudsley Hospital. The first was as follows :—

“ I appeared to be resting on the roadside when a woman (unknown) called me to see her husband’s (a comrade) body which was about to be buried. I went to a field in which was a pit, and near the edge four or five dead bodies. In a hand-cart near by was a *legless body*, the head of which was hidden from sight by a slab of stone. (He had seen a *legless body*, which was covered with a mackintosh sheet, which he removed.) On moving the stone I found the body alive, and the head spoke to me, imploring me to see that it was not buried. Burial party arrived, and I was myself about to be buried with legless body when I awoke.”

The second dream was as follows :—

“ After spending an evening with a brother (dead 11 years ago) I was making my way home when a violent storm compelled me to take shelter in a kind of culvert, which later turned into a quarry, situated between two houses. Men were doing blasting operations in the quarry, and whilst watching them I saw great upheavals of rock, and eventually the building all around collapsed (explosion of a mine). Amongst the débris were several mutilated bodies, the most prominent of which was *legless*. I tried to proceed to the body, but found that I was myself pinned down by masonry which had fallen on top of me. As I struggled to get free the whole scene appeared to change to a huge fire, everything being enveloped in flames, and through the flames I could still see the *legless body* which now bore the *head of my wife*, who was calling for me. I was struggling to get free when *my mother* seemed to be coming to my assistance, and I awoke to find the nurses and orderlies standing over me.”

It appears that the patient had been shouting in his sleep, beginning in a low voice and gradually becoming louder until eventually he was shrieking. The *legless body* occurred in all his dreams; the sight of this had evidently produced a profound emotional shock. He had worried a great deal about his wife, who was much younger than himself, so that we have this incongruous association of the *legless body* and the *head* of his wife calling him; finally, what more natural than that the *mother* should come to his help? The emotional complex is not incongruous in this dream, for fear is linked up with the tender emotion.

War Psycho-neuroses

The psychopathology of war consists fundamentally in the exaggeration and perseveration of instinctive defence reactions incidental to normal physiological conditions, viz. protective pain, fatigue and emotion. This is clearly shown by a consideration of the somatic and psychic signs and symptoms of the two great groups of functional psycho-neuroses, hysteria and neurasthenia.

Babinski, whose views are now widely accepted, thus defines hysteria, which he calls pithiatism (*πειθώ*, persuasion; *ίατός*, curable).

“Hysteria is a pathological state manifested by symptoms which it is possible to reproduce by suggestion in certain subjects with a perfect exactitude, and which are susceptible of disappearing under the influence of persuasion (contra-suggestion).”

Some authors have criticised this definition, maintaining that persuasion or contra-suggestion can also cure non-hysterical neuropathic symptoms, in particular those occurring in neurasthenia.

Babinski remarks there is a confusion here, for it is recognised that the phenomena of fatigue (essential characters of neurasthenia) are not susceptible of cure by contra-suggestion; the symptoms which are made to disappear by persuasion are hysterical complications grafted on to neurasthenia. For thirty years Babinski claims that he has insisted upon the frequency of associations of this kind. The association of hysteria and neurasthenia is especially common in the case of soldiers who have been exposed to modern trench warfare.

Dejerine thus defines neurasthenia: “Neurasthenia is constituted by the ensemble of phenomena which result from the non-adaptation of the individual to a con-

tinuous emotive cause and struggle of the individual for this adaptation."

Neural fatigue or nervous debility is neither neurasthenia nor hysteria. We may consider a condition as neurasthenic if, to the phenomena of fatigue, there is superadded a state of continued emotivity upon which can be grafted obsessing preoccupation.

Dejerine lays great stress upon the important rôle of emotion and emotivity in the genesis of psycho-neuroses, and a study of war psycho-neuroses confirms this opinion. He remarks that a great number of functional neuroses may be regarded as crystallisations of emotive phenomena.

The emotion may be of internal or external origin. External emotive excitation creating what has been called emotive shock is the most frequent cause of hysteria.

The points to which I wish to draw special attention, and which form the essence of Dejerine's definition, are *continued emotivity and preoccupation causing a persistent neural exhaustion*; in fact, an anxiety-neurosis. In both types of psycho-neurosis the constitutional factor plays a predominant part. Neurasthenia (nervous exhaustion) with mental preoccupation is more likely to be acquired in officers of a sound mental constitution than in men of the ranks, because there is in the former the sense of responsibility which, in the officer worn out by prolonged stress of war and want of sleep, causes anxiety lest he should fail in his duties. He fears that his memory may fail at a critical moment, and anxiety weighs heavily upon him; mental preoccupation leads to a continued struggle to overcome such doubts and fears.

Psychogenic Motor Disorders and Disabilities

In considering the motor disorders and disabilities occurring in soldiers coming back from the front, we have to bear

in mind that an organic lesion may be accompanied by a large halo of functional disturbance, or an organic lesion may by suggestion lead to a functional paralysis, contracture, or other motor disturbance. It is, therefore, essential to inquire carefully into the history of the onset of the motor disability. For it may be found that the subject had suffered with commotion or concussion of the skull or of the spine, and that this was followed by a paralysis of organic origin, but although the organic condition may have cleared up, yet the patient remains paralysed as the result of auto-suggestion. Many cases of this kind have occurred in my practice.

Again, a patient may have an injury of a limb from a gunshot wound, necessitating the use of a splint, and when this is taken off, the limb is left in a state of functional paralysis. Or, a man is blown up and falls on his shoulder, his side, or his spine, and he develops in consequence a brachial monoplegia, a hemiplegia or paraplegia of functional origin. But we must be sure that there is not some organic lesion, especially of a joint or of the spine, to cause a contracture or paralysis. For instance, shrapnel wounds and other injuries may set up reflex irritation, and an antalgic attitude may be assumed which becomes a fixed habit.

Before, however, discussing in detail the hysterical paralyses and contractures, it is necessary to call attention to the fact that Babinski and Froment prefer to keep the term functional for those motor disorders which can be cured by psychotherapy, and they put in a special category reflex contractures and paralysis arising in consequence of a wound or traumatism, which without showing the characteristics of motor organic disease are to be distinguished from functional disorders by the absolute inefficacy of physio-psychotherapy. They state, moreover, that these reflex disorders may be distinguished from hysteria by the following signs: (1) Vaso-motor disturbances, often occupying the whole of the affected limb or a segment of

it, *e. g.*, cyanosis, blue markings, salmon-red coloration. (2) Local hypothermia of a more intense degree than in hysteria. (3) Muscular atrophy, "moist" skin, sometimes even of a macerated appearance; rarefaction of the bones revealed by X-ray examination; muscular hypotonus at the level of certain articulations; mechanical hyperexcitability of the muscles corresponding to modifications of electrical excitability; the disappearance of the contracture in profound anæsthesia; and in deep anæsthesia, after the extinction of all the other reflexes, a clonus of the patella can be induced in the affected leg.

Sollier attributes most of the disorders following slight wounds or injuries to Charcot's classical hysteria, and sees in them the confirmation of his theories in the physiological origin of hysteria. He attributes great importance to kinæsthetic disturbances, particularly to the disturbances in the deep sensibility of joints. I have found that cases of intractable functional paralysis generally have a loss of deep sensibility in addition to cutaneous anæsthesia.

Claude remarks thus: "Among the large number of 'blessés nerveux' who passed through the eighth region I have never noted these functional disorders in high-spirited officers who were eager to leave as soon as possible, nor in doctors." Non-commissioned officers and soldiers who showed paralysis or contractures of a particular kind were constitutional psychopaths and generally exhibited hysterical manifestations. He attributes an important rôle to the mentality of the individual in the genesis of the functional motor disorders which are not purely hysterical.

Doubtless the psychopath by "meditation" converts the normal protective pain reflex into a psychogenic reflex; for the onset of the contracture or paralysis may not be immediate but may develop slowly and progressively, often in consequence of prolonged immobilisation of the limbs

on a splint, or as a result of inopportune suggestion by daily massage and electrification by sympathetic nurses. With the improved treatment and morale of the French Army the number of cases of paralysis and contracture following slight injury have enormously diminished.

The contracture may affect the upper or lower limbs. When the upper limbs are affected the hands assume a characteristic form of contracture known as "*main figée*" (congealed hand).

What is the mechanism of these contracture disabilities occurring in limbs with a slight lesion? Is it a reflex irritability of the motor cells of the spinal cord, or is it due to reflex inhibition of the motor cells presiding over the groups of muscles which oppose those in contracture which cannot be cured by physio-psychotherapy, or is it the result of myogenic changes?

Babinski assigns to the sympathetic nervous system an important *rôle*, and points to the vaso-motor, secretory and thermal disorders in support of this view. But the following case of Roussy, and one of my own, tend to show that the vaso-motor, thermal, and secretory disturbances may be due to hysterical immobility.

Gustave Roussy has published a case which does not seem to support the reflex theory of M.M. Babinski and Froment. A typical case of functional paraplegia occurred suddenly in consequence of the bursting of a shell; there was no wound apparent. No signs of an organic lesion were observed. The paraplegia was of the *astasia-abasia* type; it was not therefore *hystero-organic*. About ten months later there existed a pronounced hypothermia of several degrees, with cyanosis and hyperidrosis of both feet, associated with disappearance of the plantar cutaneous reflex on one side and a great diminution on the other.

Abolition of the plantar cutaneous reflex is disputed in a purely functional paralysis. Certain authors, Dejerine, Sollier, and L'Hermitte, explain it by *anæsthesia* disturbing the reflex path. Others with Babinski associate it with hypothermia. Roussy accepts the latter explanation, for

after warming the feet in this case the reflex appeared, but without affecting the plantar psychic anæsthesia. Even though there was a temporary retention of urine, this case was without doubt purely hysterical. He was cured by physio-psychotherapy in fifteen days. All the paralysis, the vaso-motor and secretory disturbances disappeared. Roussy asks, are these vaso-motor, secretory and thermal disorders described by Babinski therefore of reflex origin, or, as his case seems to show, due to hysterical immobilisation?

The following case which came under my notice also clearly demonstrates the fact that the vaso-motor, thermal and secretory troubles may be dependent upon immobility.

An Australian private soldier was admitted to the Maudsley Hospital under Dr. Collier suffering with a complete flaccid paralysis of the right arm. He had been treated with faradism without success. The right arm was adducted to the trunk; the elbow slightly flexed; the wrist slightly flexed; the fingers and thumb were semi-flexed, and all parts of the limbs were voluntarily immobile. There was acro-cyanosis, hypothermia, sweating and insensibility of the hand. There was a large superficial cicatrix of a pre-war burn on the right forearm, on its upper and postero-external surface; in the middle a cross had been tattooed. Attempts at passive movement caused spasm of the flexors of the forearm. He gave the following history: On December 19th, 1917, he had been wounded by shrapnel on the right forearm, in the region of the scar. He was for a moment dazed; after a field-dressing had been applied he carried on. One hour after the injury he noticed numbness in right arm and the numbness persisted. One week later he had an attack of trench fever and at the same time he developed (overnight) paralysis of the arm, and it had remained completely immobile ever since, and insensitive until he came under my treatment, which consisted of strong suggestion and exercise of associated movements—at first passive, later active. As the mobility of the limb returned, so the vaso-motor, secretory and thermal disturbances disappeared.

He is now completely cured (*vide* Figs. 35, 36).

Babinski admits that hysteria may be associated with these physiopathic conditions or with mental disorders.

The following case which came under my care supports this in a very convincing manner.

This man was in France from August to November 1915, during the latter part of which period he was nervous and apprehensive. From December 1915 to September 1916 he was on home duty because of his condition. In June 1917 he returned to France and when under fire he was paralysed with fear and trembled constantly.

In October 1917 he was blown up and buried. He was unconscious for a short time, and upon recovering he



FIG. 35.—Condition of right arm before treatment.

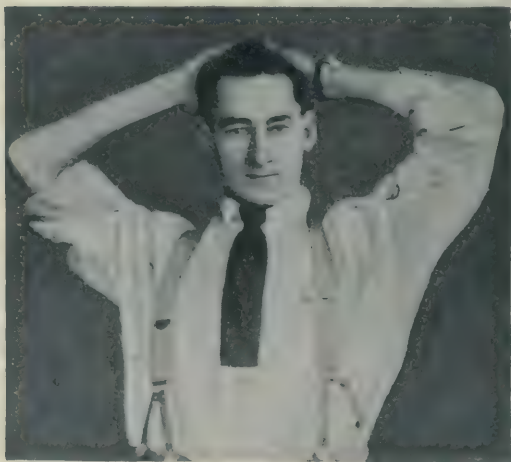


FIG. 36.—Condition of right arm after treatment.

experienced severe pain in the back. For nine weeks he was confined to bed with pain in back, headaches, and terrifying dreams.

When he entered the Maudsley Hospital, 4th London (March 15th), he had moderate camptocormic, walked in a stiff and constrained manner, with the trunk bent forward and the head slightly thrown back, and complained of constant pains in back, and headache.

About eighty per cent. of the deformity recovered under faradism and persuasion; but a residue remains. At present

there is a definite spasm of the lumbar muscles, more marked on the left; immobility from first lumbar down; pain and limitation on hyperextension of spine; and definite local tenderness over left sacro-iliac joint. There is a zone of anæsthesia and analgesia in the back below the angle of the scapulæ, which has been greatly diminished by contra-suggestion, so that eventually it was limited to the lower lumbar sacro-iliac regions. X-ray shows a pathological process involving the left sacro-iliac joint.

This case shows that reflex contracture may be associated with a large halo of functional disorder which can be cured by suggestion, but there is a residuum which cannot be cured. Before, therefore, it is asserted that a paralysis or contracture is wholly pithiatic we must take care to leave no stone unturned to show that there is no lesion which might give rise to reflex paralysis or contracture; for the ascertainment of this fact is of great importance in respect to the award of gratuities or pensions in case we adopted the recommendation of the French and German neurologists of no home service and no gratuities for purely hysterical symptoms. Whereas if there is a lesion, even though it be slight, the disability is more difficult to cure, and in some cases cannot be cured by physio-psychotherapy; consequently the French recommend in such cases temporary auxiliary service and gratuity.

The physiopathic organic disorders may not only be associated with hysterical manifestations and with nervous and mental disorders, but with more or less obstinate neurasthenic symptoms, with psychasthenic states, with mental confusion, and with less grave mental disorders. It is generally recognised, however, that hysteria and traumatic neurosis never determine dementia.

It is manifest that in all the above-mentioned combinations the hysterical factor is amenable to immediate and successful treatment, consequently all the other disorders and disabilities should alone count in all that concerns temporary or permanent incapacity. This,

however, should only hold good when our doctors can all diagnose and treat these functional cases at the earliest possible moment and before they have become fixed and firmly installed.

There are three stages in the development of hysterical paralyses and contractures: (1) An instinctive reflex defence reaction, often against pain, by immobilising the affected part. (2) The psychogenic stage in which there is perseveration and exaggeration of this defence reaction. (3) Late phenomena of prolonged immobility, viz. wasting of muscles, adhesions in joints and their fixation, associated with vaso-motor, thermal and secretory disturbances.

The Mental Conflict in Relation to War Psycho-neuroses

The psychopathic officer is likely to be the subject of a continuous mental conflict. He feels deeply the responsibility which rests upon him to do his duty and put up with an intolerable situation. He is apprehensive lest his comrades should, by his actions or expression, discover the cause of his anxiety. He may, in consequence, become a danger to himself and others; for, feeling that his comrades look upon him as a coward, he may engage in a foolhardy enterprise causing his own death and perhaps that of many of his company. If he is not killed by the enemy, he may become depressed and suicidal; he may desert his post, or surrender to the enemy; more often relief comes, by shock, emotional or commotional, followed by a psychosis or a psycho-neurosis. He may be wounded, in which case he obtains relief from an intolerable situation in the most satisfactory manner to his *amour propre*; for the existence of an obvious physical disability affords him a means of escape from such a situation without any wound of the moral sense; his mind is not tormented by the thought that he will be regarded as a shirker, and the mental con-

flict between the concealed desire which he has had to escape the dangers and discomforts of trench warfare and the moral obligation imposed by duty and patriotism ceases. When he can show a wound-stripe the anxiety caused by the feeling that he is regarded as a shirker is relieved and thus helps materially in the relief of the neurasthenic symptoms. Anxiety-neurosis is a far more common condition in officers than hysteria. In non-commissioned officers and men hysteria is common. The more important and evident manifestations of hysteria are those which provide the patient with a means of escape from the front. These have been called by McCurdy conversion hysterias; a useful term, as it represents a well-recognised fact that these motor and sensory disabilities are due to an idea being transferred into a physical symptom. The desire not to return to the front and the provision of the means of escape fixes unconsciously the idea of a disability which originated by auto- or hetero-suggestion. In our conscript army the number of cases of hysteria has been proportionally greater than in the old professional army. Prolonged discipline left its mark upon the character and mental attitude of the professional soldier towards military service. The fear of punishment is greater with them than the fear of death in action, and prolonged discipline has made the professional soldier's mind highly suggestive to the commands of his superior officers, and provided his officer shows no fear he will follow him anywhere in obedience to orders.

Hysterical Paralyzes and Contractures

HYSTERICAL HEMIPLEGIA.—Hysterical hemiplegia with contracture or hysterical hemicontacture develops all at once, and is therefore not like hemiplegia of organic origin, which commences by a flaccid paralysis, followed later by a spastic condition; moreover, neither the face nor the

tongue are affected in hysterical hemiplegia, except in very rare cases. The following case, although not one of hemiplegia, is of interest.



A



B



C



D

FIG. 37.—? Functional facial paralysis simulating Bell's palsy. All the muscles were reported to respond to the lowest condenser current. A, Normal Expression. B, Told to close both eyes. C, Told to smile. D, Told to frown.

*Functional Facial Paralysis Following Shell Shock and
Burial with Hysterical Hemianalgesia*

December 26th.—Platoon mending barbed wire, and they were in an old German dug-out, having a drink of tea. Above this dug-out in which he was there was another connected by steps. A shell burst on the top one, and this filled the lower

dug-out, all but completely covering him except on the left side of his face, by which he was enabled to breathe. He was unconscious for three days; he wanted to know where he was. He knew nothing of what had happened himself, and the above information is the result of what he was told by a comrade who had not been buried but had his arm blown off. He was in Le Treport Hospital over three weeks, and then sent to England and placed in the Suffolk Hospital, Bury St. Edmunds, from January 27th to March 9th; sent to convalescent home from March 9th to June 9th, then transferred to 4th London. He has been seen by a great number of doctors at Le Treport, and they found the same condition that I found. His face has not changed. He has been X-rayed without result. He remembers going into the dug-out, and he hears in his mind the shell coming. He has terrifying dreams of his experience at the front.

He has been seen by Capt. Clayton, who finds that all *the muscles of the face on both sides respond to the lowest condenser*. The expression: the left eye is prominent, the inner canthus is wider than natural, tears do not run into the lachrymal ducts. Pupils equal, react to light and accommodation. Conjunctival reflex absent on left side. There is absence of wrinkles over forehead of left side, and a lack of expression. When asked to frown the left frontal region becomes wrinkled. The right eyebrow is at a higher level than the left. On being asked to show his teeth, the left side of mouth is only half opened. When asked to give a graceful smile, a response is only on the right side, where there is a dimple, and the risorial muscles act well; on the left there is a blank. On being told to blow out his cheeks, the right side is effective, the left not. He complains that he has loss of sensibility of the tongue on the left side, also of the lips and cheeks, and he cannot taste on that side, and he has to press out the food which gets between the cheek and the jaw. He hears a tuning-fork, and there is no deafness in either ear. The tongue when protruded deviates to *the right*, but he can move it about to either side. He says his mouth is dry on the left side.

There is a complete hemianalgesia to pricking, and a thermo-anæsthesia of the left half of the body. He feels a prick of the left side of the urethral orifice as well as upon the right. He asserts he does not feel on the left half of the body anywhere, but he stated that he felt pricking on the lower half of the left side of the abdomen. The abdominal reflexes were easily obtained. There is no loss of power or wasting of the muscles of the trunk and limbs. The deep reflexes are normal. The plantar reflex on the left side is not easily obtained, and

is mainly flexor of the small toes, with but little movement of big toe. He feels the vibrating tuning-fork all over right side, but says he does not feel it on the left. He hears it at a distance of a few inches from left ear, but at ten inches from right ear. He does not hear it over left forehead, but faintly over left malar bone; whether this may be associated with the fact that hearing on left ear is deficient as compared with the right is a possible reason.

On turning him round several times and with his eyes shut, he feels giddy, and would fall to the right. No Romberg symptom. No nystagmus. The result of Capt. Clayton's examination shows that there is no nerve lesion now. The only explanation I can offer is that this case was one of a functional perseveration of an original Bell's Palsy. Unfortunately I have been unable to follow up this case further.

There are two forms of hysterical hemiplegia: in one there is an intense contracture of the upper and lower limbs, the lower limb is in extension and the foot in a position of talipes equino-varus, the whole limb being absolutely rigid; the upper limb may assume a flexed position or one of extension; in either case there is a rigid contracture. The other form is characterised by a flaccid paralysis of the upper limb, which hangs quite inert by the side of the body. The gait is unlike that of organic hemiplegia; there is no circumduction of the paralysed leg, which is dragged forward without raising the sole of the foot from the ground. Hysterical contracture of a limb is marked by its intensity, the joints being firmly immobilised, so that the whole limb is rigid. Although the contracture may be overcome by sudden application of force, the limb immediately returns to its former position when the force ceases. This contracture is very difficult to simulate by voluntary action without the manifestation of expenditure of great effort, as shown by the facial expression, irregularity of movement, and by the respiration. Hysterical hemiplegia is rarely met with as a result of a wound.

A diffuse amyotrophy of the muscles occurs in all old

hysterical hemiplegias; the electrical excitability, both faradic and galvanic, is retained, although it may be diminished; there is, however, no reaction of degeneration.

A muscular tremor resembling the waving of a field of corn in the wind may occasionally be seen when the cool air excites the skin; but, according to Pierre Marie, this may be seen also in organic hemiplegia. Vaso-motor disturbances, lowering of the surface temperature, cyanosis of the paralysed extremities, hyperidrosis and œdema may be found, but they are the result of prolonged functional inactivity and immobility. The fact that these vaso-motor troubles disappear rapidly when the patient is cured of the paralysis by electro-psychotherapy is a proof of their functional origin.

Hysteric Monoplegias and Paraplegia

BRACHIAL MONOPLÉGIA.—There are two types of brachial monoplegia, the flaccid and the spastic, the former being more common. In the flaccid type the paralysis is more complete, no movement being possible, the upper limb swinging like a flail at the side of the body and falling inertly when the patient displaces it with the sound limb. The shoulder is lowered, the forearm remains in passive extension; the hand also is extended with the fingers straight and abducted, and the patient is incapable of executing the most simple movement. A case of this type was recently sent to me for treatment by the Pensions Board. He was wounded by shrapnel at Loos, for which he underwent an operation. There are two linear scars on the left upper forearm; the limb hangs like a flail at his side (*vide* Fig. 38). He says that he lost the use of it soon after he was wounded. All the muscles of the shoulder, arm, forearm and hand are wasted, but respond to a fairly strong faradic current. From the elbow to the apex of the limb there is a complete loss of superficial and deep

sensibility. Above the elbow both forms of sensibility are diminished. He has completely lost joint and bone sensibility in the wrist and hand, and he does not feel the prick of a needle nor the strongest faradic current in

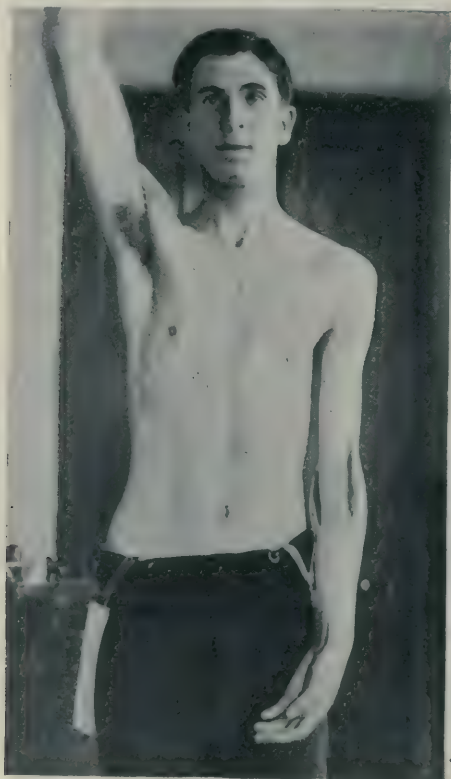


FIG. 38A.—The photograph shows the complete immobility of the whole limb. It will be observed that the scars of the wound, which would be hardly visible had they not been painted to show their position, could not possibly account by a nerve lesion for the paralysis of the shoulder muscles.

the hand and forearm. The hand was at first cold and blue, but with daily massage, electricity and passive movements both the acrocyanosis and the muscular atrophy have greatly improved. In spite of the improvement in the

FIG. 38B.

Pensioner, wounded at the Aisne in 1914. Scar at entrance of bullet three inches below spinous process at outer edge of scapula. A large linear scar from left sterno clavicular articulation to middle of deltoid. The bullet penetrated the lung and was removed. Seven months in hospital, arm immobilised. Discharged from the Service, and pensioned since. Complete functional paralysis of left arm. Adduction of shoulder. Slight flexion of elbow. Flexion and pronation of wrist. Flexion of metacarpals and phalanges. General wasting of muscles. Fixation of joints. No loss of superficial or deep sensibility. All muscles respond to Faradism. The skin of the palm of the hand is macerated and sore with the mark of the nails. An X-ray examination which I have had made showed a fracture of the neck of the scapula.

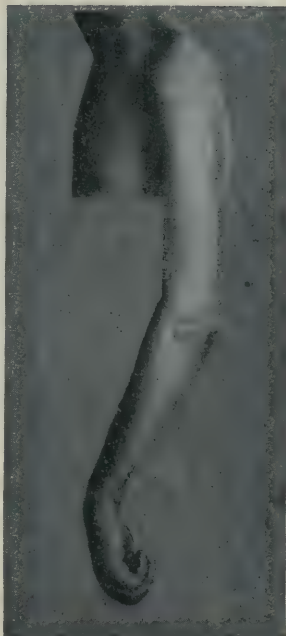


FIG. 38C.—After a month's treatment he is able to use his arm and hand; he can use a fork and can grasp objects. He has continued to improve since the photograph was taken.

muscles, he is unable to perform any movement of the apœsthetete limb. We must suppose that owing to the length of time the limb has been inert and apœsthetete a cortical dissociation of the sensory representation of this portion of the ego has been firmly installed and organised. Before the will can operate upon a part of the body consciousness of its existence and relative position of its parts are essential. It is somewhat similar to a functional deaf-mutism. This may be contrasted with another case of brachial monoplegia following a gunshot wound in 1914. The bullet passed through the left scapula at its border and lodged in the front of the chest below the clavicle; it was removed. There is a long scar beneath the left clavicle; there is wasting of the whole of the muscles of the limb, particularly of the deltoid; there is a paralysis of the arm, the wrist is flexed, and the fingers and thumb flexed in the palm (*vide* Fig. 38B). There is no loss of sensibility. Whereas the patient with the apœsthetete limb after six weeks' treatment has shown not the slightest sign of voluntary movement, although the muscles have developed well, the patient with no loss of sensibility after a few days' treatment has begun to move the fingers and wrist, and overcome the flexor contraction by extension (*vide* Fig. 38, B and C).

In the flexor type of contracture the forearm is more or less flexed upon the arm in both varieties of contracture; the fingers are flexed upon the palm, sometimes accompanied by flexion of the wrist (*vide* Figs. 39, 40). The closed fist with extension of the wrist is much rarer.

In contradistinction to contractures from an organic cause, every attempt to move the limb is without effect and may only exaggerate the intensity of the contracture. The application of an Esmarek bandage, which, as Brissaud has shown, causes organic contractures to cease, exaggerates functional contractures or makes no difference.



FIG. 39.—Functional hemiplegia with semiflexion of wrist and fingers, cured by physio-psychotherapy.



FIG. 40.—Functional brachial monoplegia with paralysis of extensors of wrist and fingers, cured by physio-psychotherapy.



A

FIG. 41.—A, Functional right brachial monoplegia.



B

B, Cured by physio-psychotherapy.

Figures 39 and 41 are photographs of officers suffering with hysterical paralyses.

CRURAL MONOPLÉGIA.—This form of monoplegia is less frequently met with than the brachial. There are two types, the flaccid and the spastic; the former is very seldom seen and is very rarely complete: the patient always remains capable of executing some voluntary movement and is able to walk with the aid of crutches or sticks. During the automatic movement of walking with crutches, muscles are seen to contract which remain

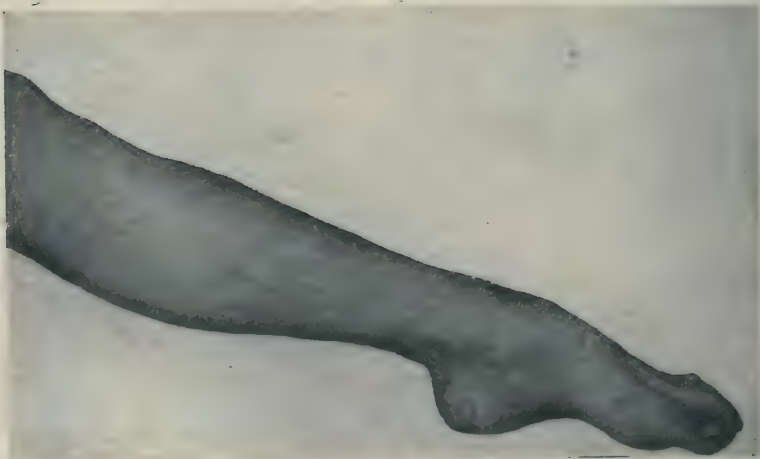


FIG. 42.—Functional contracture with extension and talipes equino-varus of long standing, cured by physio-psychotherapy.

immobile when the patient is lying down. In the case of contracture of the lower limb the usual attitude is that of forced extension with equinism of the foot, sometimes excessive, accompanied by plantar flexion of the toes. Usually the foot takes the position of talipes equino-varus, at other times a talipes with an excessive flexion of toes may occur. Contracture in extension is the rule (*vide* Fig. 42).

Crural monoplegia with contracture is one of the commonest forms of war psycho-neurosis.

THE FLEXOR TYPE.—The leg is flexed incompletely upon

the thigh and the thigh upon the pelvis; the foot rests upon the ground by the anterior extremity. Both active and passive movements are extremely limited, and only by employing great force is it possible to correct the vicious position. The gait is painful, slow, and characterised by a particular form of lameness. This type is comparatively seldom seen. The more common type is the following.

THE EXTENSOR TYPE.—Inasmuch as the leg is absolutely straight in extensor contracture, progression is only possible by an elevation of the pelvis on the affected side, which is necessarily accompanied by a curvature of the spine with the convexity directed away from the sound side. The foot is not always in a condition of extension, but may be immobilised in the normal position. In such a case walking is easier, because the sole of the foot rests upon the ground, but the toes are usually extended; moreover, since there is no tilting of the pelvis, the compensatory spinal curvature is not necessary. The patient is able to walk by dragging the foot along the ground.



FIG. 43.—Case of long-standing functional paraplegia, cured by physio-psychotherapy.

PARAPLEGIA.—This is the commonest type of paralysis met with in war psycho-neuroses. There are two types, the flaccid and spastic. In the flaccid form the lower limbs remain extended and immobile while the patient is lying in bed; he is unable to move them or even to make a single muscle contract. All passive movements are made with the greatest of ease. It is only by the aid of the upper limbs and crutches that the patient is able to get about; as he swings himself along it may be noticed

that the paralysed limbs execute movements, albeit with but little strength; also that certain muscles which were incapable of contracting voluntarily when the patient is lying in bed on his back, may be observed to contract during progression with crutches (*vide* Fig. 43).

SPASTIC PARAPLEGIA.—The only type is that of rigid extension and adduction, causing the knees to touch and to cross one another; the feet participate in the con-



FIG. 44.—Case of functional spastic paraplegia, *vide* the scissor-like position of the legs in walking, cured by physio-psychotherapy.

tracture and tend to take on the form of talipes equinovarus (*vide* Fig. 44).

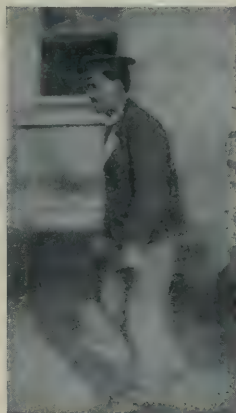
Contractures of the Trunk

Contractures of the trunk muscles are of common occurrence, and have appeared almost as a new type of contracture since the war. The form most commonly met with is a curvature of the trunk forwards, so that the man stands and walks with his trunk bent forward and head more or less thrown back, usually supporting himself with a stick in either hand, the thighs are rotated outwards, and there is abduction of the feet. The French

term this condition "plicature" or "camptocormie" (*vide* Figs. 45, A, B, C). It frequently arises in consequence of a man being blown up by an exploding shell or mine; it is not due to an organic lesion, but is a functional psychomotor contracture brought about usually in the following manner. When the patient recovers from the unconscious or dazed state caused by the explosion, which may have led to contusion of the lower part of



A



B



C

FIG. 45.—A, Case of functional curvature of spine (camptocormie).
B, Improved by treatment. C, Cured.

the spine by burial in a trench or dug-out, he finds that to assume the erect position causes him pain. The pain in the first instance causes an instinctive protective reflex to immobilise the injured part which the will is powerless (and from a psychological point of view should be powerless) to overcome. But if this protective reaction persists, evacuation follows, and with it arises the fulfilment of a wish to escape from an intolerable situation, the effect of which is to reinforce consciously and unconsciously the idea of pain if the erect posture were assumed. The normal pain reflex is thus trans-

formed into a psychogenic reflex and a vicious circle is eventually established; for the persistence of the contracture may actually cause pain by stretching of the ligaments, which, reacting upon consciousness, still further inhibits will power to make endeavours to overcome the disability. Certainly these patients with pseudo-spondylitis do not remain in this vicious attitude because pain is thereby relieved, for if they continue to suffer pain it is by reason of the fact that the vertebral ligaments are stretched by the abnormal position of the trunk; and the proof of this is that, as soon as the subjects of this affection are cured by physio-psychotherapy, the pain in the lumbar region disappears.

Functional Paralysis or Contracture of a Circumscribed Region of the Hands, the Feet, the Shoulder, the Trunk and the Neck

Functional paralysis of one hand or both hands, one foot or both feet, may be rarely met with.

In the *hand* the paralysis is absolute and generally flaccid, consequently there is wrist drop; there is inability to flex the fingers, the thumb alone being capable of performing any movements, and these are limited. The skin of the hand and forearm is usually analgesic.

When the *foot* is paralysed there is foot drop and the sole is slightly turned inwards, as in talipes equino-varus. There is a complete loss of voluntary movement; all passive movements are, however, possible.

Vaso-motor disturbances and disuse atrophy of muscles may come on, together with some alterations of electrical reactions.

Various contractures of the hands and feet may occur. The hand contracture may take on the following forms: the hand of the accoucheur is the most frequent type of

hysterical acro-contracture. The fingers are in close contact with one another in extension, the first phalanges slightly flexed, the thumb extended and adducted, and

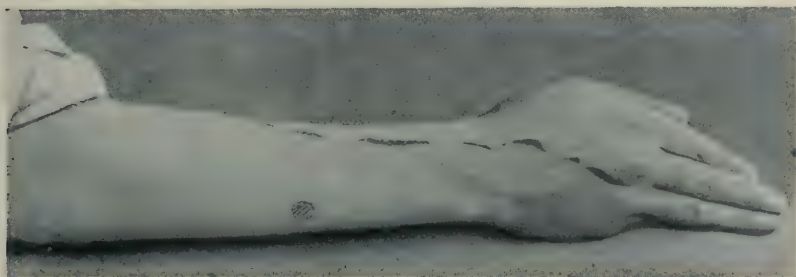


FIG. 46.—Accoucheur hand, gunshot wound of arm affecting the median nerve. Area of superficial anæsthesia shown. There was a complete loss of deep sensibility in the thumb. The fingers and thumb could be forcibly separated, but immediately returned to the former position. A fibrillary spasm was observed in the muscles of the thumb when it was extended. Under chloroform anæsthesia (*vide* Fig.) the contracture only partially disappeared.

its palmar surface opposing the index finger (*vide* Fig. 46). As a general rule passive movements are impossible on account of the rigid contracture of the muscles.

There are other forms of contracture: (1) the fingers



FIG. 47.—Functional paralysis of hand in consequence of superficial burn of hand, five months' duration. The joints of the fingers and wrist had become fixed in extension owing to the splint applied. After breaking down the adhesions he was able to separate the fingers and flex them.

are extended and closely approximated, the thumb extended but not adducted into the palm (*vide* Fig. 47) (*main en bénitier*); (2) the fingers closely approximated,

the phalangeal joints extended, the metacarpo-phalangeal joints flexed (*main en tuile*); (3) the fingers and thumb approximated, with flexion of the fingers at the metacarpo-phalangeal joints, and the wrist like the beak and head of a bird; (4) it may resemble the contracture due to a lesion of the ulnar nerve, but without the extreme wasting of muscle (*vide* Fig. 48); (5) the fingers are approximated closely and semiflexed at all the joints, the thumb is adducted,



FIG. 48.—Functional *main en griffe* simulating an ulnar paralysis, cured by physio-psychotherapy.

the palm is hollow as when the hand is used as a drinking cup (*vide* Fig. 49).

Talipes equino-varus is the form usually met with in contracture of the foot (*vide* Fig. 42).

The evolution of the acro-contracture of psycho-neurotic origin is not so unfavourable as the paralysis. If these contractures are not treated, but allowed to persist for some time, relaxation of ligaments and deformities of the articular and osseous structures occur.

CONTRACTURE OF THE CALF MUSCLES.—A remarkable case came under my notice. A soldier was in a transport which was torpedoed in the Mediterranean; he was four

hours in the water, which was very cold. He suffered with a contracture of the gastrocnemius and soleus muscles of the right leg, which had persisted for a year, and which he attributed to a cramp in the leg at the time. Some authorities thought it was a reflex spasm, but no cause could be found, and it was completely relaxed under chloroform. Also it could be partially relaxed by forced continuous dorsal flexion of the foot.

Pains are caused by dragging on the nerves and tendons

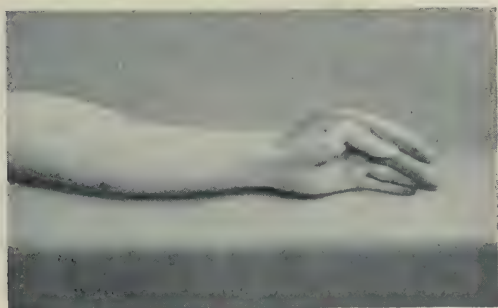


FIG. 49.—Functional paralysis of hand, cured by physio-psychotherapy.

in contractures, especially when passive movements are undertaken to correct the deformity. If the contracture is not cured, deformity in vicious positions occurs with organic changes in the structures involved.

Various other contractures of one or several muscles or groups of muscles may occur. Thus there may be torticollis due to contracture of the sternomastoid and trapezius muscles, and contracture of the muscles causing retraction of the neck, simulating thereby meningitis.

Disorders and Disabilities of Gait and Station

Ataxia may occur in the subjects of neurasthenia or hysteria; in the former the ataxia resembles cerebellar

disease. The symptoms are inco-ordination, vertigo, uncertainty in walking and oscillation of the body, but the disorder of gait and station never attains the same intensity as in cerebellar disease. In hysteria the ataxy may resemble any form of ataxy due to organic disease, and spino-cerebral or even bulbo-pontine conditions may be simulated.

ASTASIA-ABASIA.—Charcot distinguished two principal forms: (1) paralytic astasia-abasia; (2) ataxic astasia-abasia, which may be either choreiform or trepidant. Both varieties are frequently met with in cases of shell shock, whether the shock be commotional or emotional. The characteristic sign of this functional disability is the fact that the patient lying in bed can voluntarily execute all movements of the lower limbs, although he is unable to stand or walk.

PARALYTIC ASTASIA-ABASIA.—The inability to stand or walk varies in degree of intensity in different cases. In some cases it is absolutely impossible for the patient to rise from the chair, or much less to hold himself up and walk. When the attempt is made the thighs are immediately flexed upon the pelvis, the legs upon the thighs, and the patient falls down on the ground if he is not held up under the arms. It seems as if he had forgotten how to stand or walk. In other cases the disability is less pronounced. The patient can still rise from the bed or chair and stand up, but the moment he tries to walk the feet seem glued to the ground, and each foot is only raised from the ground with great difficulty. Nevertheless, the patient lying in bed can perform all movements with energy and without difficulty.

Sensibility is generally intact, and there is no loss of muscular sense or sense of position in the limbs; the functional disability cannot thus be accounted for.

In some cases the difficulty in walking only occurs after the patient has taken a few steps, then the knees give way



A



B



C

FIG. 50.—A, Ataxic astasia-abasia. B, Improvement. C, Cured.

and he is no longer able to advance, and if he does not sit down he will fall. This latter condition is really due to fear that he will fall down—staso-basophobia—and is not an uncommon condition.

ATAXIC ASTASIA-ABASIA is a condition sometimes seen in which it is observed that the moment the patient puts his

feet on the ground the lower limbs become agitated by inco-ordinate, irregular, violent movements which make it difficult for him to maintain his balance. Even if he is held up under his arms and tries to walk with this support the muscles of the legs and thighs become suddenly thrown into successively rapid movements of flexion and extension (*vide* Figs. 50, A, B, C). This form of astasia-abasia is sometimes called choreiform; it is also unattended by sensory disorders. The upper limbs are not affected in this functional motor disability of astasia-abasia. Cases occur in which a man is able to make progression, although owing to the jerky inco-ordination the walking may resemble dancing or look as if the man were on wire springs. Occasionally cases are seen in which progression is made by little jumps. One patient under my care would take a few steps and then break into a rapid double shuffle of his feet upon the ground, making but little actual progression. This case is described on p. 165.

These various forms of motor disabilities have morbid characters in common, and are of the same pathogenesis.

Treatment.—They may be cured by contra-suggestion, viz. persuasion accompanied by faradism and followed by re-education, as in the case of paralysis of functional origin, except that they are, generally speaking, more difficult to cure.

Tremors, Tics, and Choreiform Movements

It has already been shown that the signs and symptoms of the war psycho-neuroses may be regarded as a perseveration of two physiological conditions, viz. emotion and fatigue. This general principle underlying the symptomatology of the functional neuroses affecting soldiers returned

from the front is well illustrated in the case of tremors, tics and choreiform movements.

The emotion of fear plays an all-important part in the production of general tremor. In a heavy bombardment, not only soldiers who are fresh to trench warfare as well as constitutional psychopaths are seized with a general trembling of the whole body as a result of the emotion of fear, but even experienced soldiers, who have become emotive on account of prolonged stress, may be similarly affected. The crouching attitude of immobility for concealment is associated with a general muscular inertia, pallor of the skin, sweating and coldness owing to the blood being withdrawn from the superficial parts of the body to the internal structures. The tremor, therefore, may be partly due to a general reaction of shivering from cold increased in many cases by exposure to wet and cold. A perseveration of the trembling may therefore occur together with the secretory (sweating) and circulatory (tachycardia acro-cyanosis) disturbances. The initial physiological emotional reactions are transformed into a psychogenic reaction (*vide* p. 133) by the unconscious fulfilment of a wish. Likewise many of the tics are the result of perseveration of the startling and dodging reflexes, and some of the choreiform movements which I have seen seem to be due to perseveration of gesture movements of horror.

Generalised tremors and quaking are amongst the most objective signs of war psycho-neurosis; according to Rothfeld, they are always due to defective innervation and an involuntary spread of nervous impulses to antagonistic groups of muscles, and this defect is of high central origin.

THE TREMORS.—The tremors may be divided into two classes: (1) those which resemble in the frequency, rhythm and amplitude of the oscillations the tremors occurring in certain recognised diseases. (2) A typical tremor which

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does not correspond to the tremors of disease but rather to the tremblings and quakings of fear. This form of tremor is seen in cases of shell shock; it may come on when consciousness returns, but hours or days may elapse before it appears; it may affect the whole body or parts of it, especially the limbs and head.

In severe cases of shell shock the patient may lie or sit curled up, the head bent on chest, the arms fixed to the side and flexed at the elbows and wrist, the thighs flexed on the trunk and the legs on the thighs, and in this attitude all the flexor muscles may be continuously in a state of more or less rapid contraction and relaxation. This tremor may persist for a long time, as the following case illustrates.

A gunner who was blown up by a 17-inch shell in the early part of the war, and came under my care six months after the shock, was then in the state above described. After careful examination and repeated assurances that he would recover, he was completely cured.

The whole body, one half of the body, both legs, both arms, or a single arm or leg may be the seat of tremor. Its psychogenic origin is shown by its disappearance under the influence of electro-psychotherapy.

An unconscious (hysterical) atypical tremor is often consciously exaggerated, and it is difficult to decide whether such a tremor is wholly voluntary or only exaggerated.

Emotional tremor is variable in its amplitude, its frequency and duration, and tends usually to disappear some days or weeks after the emotional shock, especially if the trembler is closely watched and subjected to electro-psychotherapeutic treatment. But emotional disturbance or apprehension will bring back the tremor, especially when these soldiers are exposed to the terrors of an air raid.

The tremors which resemble those of definite diseases are : (1) fine, (2) coarse, (3) intentional.

The fine vibratory rhythmical tremor (9–10 per sec.) of neurasthenia is similar to the tremor of Grave's disease; it forms part of the neurasthenic syndrome, and may be regarded as one of the signs of neural exhaustion. It is best recognised in the separated fingers of the outstretched hand; and it is made more evident by laying a thin sheet of paper on the hand, which is then thrown into rapid vibration. Many cases of shell-shock neurasthenia also show a fibrillary tremor of the orbicularis palpebrarum when the eyelids are closed, and some exhibit tremor in the orbicularis oris. Two serious diseases show tremor of a similar character, especially in the lips and tongue, causing alterations in the speech, viz. chronic alcoholism and general paralysis. But attention to the other signs and symptoms of chronic intoxication in the former, and to the signs, clinical and pathological, of syphilitic organic brain disease (*vide* p. 173) in the latter, will enable a diagnosis to be made in a case which is complicated by one of these morbid states. In about 10 per cent. of the cases of shell-shock neurasthenia there are signs of a mild or moderate hyperthyroidism, viz. fine tremor, dilated pupils, some degree of exophthalmos, von Graefe's sign, Moebius's sign, tachycardia, palpable thyroid, and in some instances sweating of the upper lip and root of the nose. Senile tremor of old age need not be considered here. Another form of tremor which is coarser and less rapid than the preceding, viz. 5–6 per sec., is that which resembles paralysis agitans; but the age of the soldier, the absence of the characteristic signs of this disease, viz. the mask-like expression, the gait and the rigidity of the muscles, together with its curability by treatment, exclude the diagnosis of Parkinson's disease.

The intentional tremor of disseminated sclerosis may be simulated by hysteria; as a rule, however, the oscillations are of greater amplitude at the root of the limbs in the former, whereas in hysteria, it is the hand which is

most affected. Some of the following signs of organic disease, such as nystagmus, staccato speech, changes in the fundus oculi, and a plantar extensor response, will be present among other characteristic signs of disseminated sclerosis and serve for the differential diagnosis from war psycho-neurosis.

Any form of tremor may be simulated by the hysteric, and, from some experiments which have been made in my laboratory, it appears that any form of tremor may be simulated voluntarily, even the fine vibratory tremor of the neurasthenic.

The test, however, of voluntary tremor is inability constantly to maintain the rhythmical oscillations of the same amplitude and rapidity for any length of time, or while the attention is diverted, or in one hand while the other is engaged in performing another and totally different operation. Still, the practised malingerer can often maintain a tremor for a long time; generally, however, he overacts the part, and when his attention is diverted or he imagines he is unobserved the tremor ceases or varies considerably in the amplitude and the rapidity of the oscillations.

According to Ruhemann, a fine intentional tremor of the feet cannot be simulated, and he regards the same as a proof of a functional nervous disorder. The tremor of the feet is not observed when the patient is at rest, but first appears when the leg is raised. For the investigation of this tremor the knee should be slightly extended and the toes pointed. The tremor usually shows oscillatory movements of flexion-extension, whilst small ranged lateral tremors are less frequently observed, but equally characteristic. The tremor is sometimes made more definite by Jendrassik's method of reinforcement. The diminution or disappearance of this tremor affords a useful indication of the course of the disease. This fine tremor of neurasthenia cannot be removed by physio-psychotherapy, but the coarse, quaking hysterical tremor associated with pseudo-spastic

paresis can be readily cured by faradism and suggestion, *vide* pp. 272-286.

Tics.—One of the commonest forms of tic is a clonic spasm causing a lateral movement of the head as if to avoid a projectile. This is spoken of as the “dodging reflex.” Tics characterised by clonic spasms are much more commonly met with than those due to tonic spasm. Clonic contractions of the neck or of the head producing movements indicating affirmation or negation, elevation of one or both



FIG. 51.—Blepharospasm following conjunctivitis caused by Mustard Gas.

shoulders, unilateral or clonic unilateral or bilateral facial movements are variations of spasmodic tics.

Another spasm that is common is blepharospasm; this may occur as a result of a blinding flash of an explosion or by the earth or sand being blown into the eyes; it may happen in consequence of irritating gases exciting a reflex contraction, by which a habit spasm is installed (*vide* Fig. 51). These functional tics are readily cured by persuasion (*vide* Figs. 52, A, B), but they are apt to return when the individual suffers with fatigue or emotional shock.

Purposive habit spasms may be produced by shell shock,

and they occur whenever the patient is excited by a noise—the “startled reflex.” Thus, I had under my care a sergeant who had been a very successful heavy-weight champion pugilist; he had been sent home on account of shell shock after Loos. He was doing well at another hospital, when a Zeppelin raid occurred; this brought on an attack of motor excitement for which he was sent to the 4th London General Hospital. The motor agitation took the form of continuous jerking, defensive, purposive movements of



A



B

FIG. 52.—A, Functional facial spasm and torticollis. B, Improved by physio-psychotherapy. Eventually cured.

the head and shoulders as if to avoid a blow, compression of the lips and facial grimaces, such as, no doubt, he assumed when fighting. This habit spasm was accompanied by jerky upward movements of the head and eyes, and in broken utterance the word Zepp. The clonic spasms persisted for months, especially observable when a noise excited him; even the click of billiard balls irritated him to such a degree that he would, although a peaceable and good-tempered man, show resentment against the game continuing.

The spasmodic tics can often be shown to be a stereo-

typism of a reflex defensive movement. Thus an officer had a continuous backward movement of the head; he told me that it came on after his aeroplane had crashed to the ground nose downwards. When the 'plane hit the ground he threw his head back.

A common spasmodic tic is a lateral movement of the head and a dropping of the shoulder. An interesting example that this is of the nature of a persistent defence movement, doubtless made continuous by the combined effect on the subconscious mind of hearing shells coming, is afforded by the following case: A soldier who was partially deaf in the left ear, caused by a shell bursting on that side, had a lateral spasmodic tic of the head to the right with a dropping of the left shoulder—the “dodging reflex” made persistent. I stood on his left side and unawares clapped my hands forcibly so as to produce a loud noise; the defensive reaction was the dodging reflex accompanied by pushing away with the left hand and flight to the right. At the same time the patient became flushed, agitated and evinced a pained, anxious expression.

Another interesting example of the stereotypism of a spasmodic movement was afforded by a youth, who when walking, after a few normal steps, broke into a rapid series of short shuffling steps in which the feet were hardly raised from the ground. It appears that the youth had an hysterical convulsive seizure in a trench as a result of a shell bursting near. This “double shuffle” was a part of the convulsive seizure, for when the youth was hypnotised he would go through the whole performance again that occurred when the shell burst. If he were seated on a couch, his eyes kept closed and told that he was going to sleep, he would very soon fall off the couch to the right, turn over on his face, and then would follow rapid convulsive movements of the arms and legs, something of the nature of running away.

CHOREIFORM MOVEMENTS.—These are not uncommon,

although in several cases which have come under my care there was a history of chorea in earlier life; in the majority of cases the irregular jerky movements of the limbs, the head, the neck, and the facial muscles have come on after the shell shock. Thus a young lieutenant was admitted suffering with an acute choreiform condition and a marked anterograde and retrograde amnesia. Months elapsed before the choreiform movements ceased, in spite of persuasive psychotherapy; he was troubled for a long time with terrifying dreams, and his memory was almost a blank for the whole time he was in France; he had some weakness of the left leg, the opposite side to the bruise on the forehead. X-rays showed no signs of fracture, but the history of the case clearly pointed to concussion, and probably some vascular and meningeal hæmorrhages had occurred, which together with the commotion accounted for the chorea and the other profound symptoms caused by shock.

Another case is of interest from several points of view: Captain J—, age twenty, was admitted December 18th, 1915, exhibiting a purposive motor delirium like that of a man suffering with terrifying hallucinations; thus he sat up in bed muttering continuously, moving his head and body from side to side, stretching out first one hand and then the other as if pushing away some hateful object, alternating this movement by that of passing his hand across the forehead. There appeared to be a perseveration of the gestures of horror. When, however, his mind was diverted by conversation he would answer questions rationally and the movements would become quieter, although his utterances remained jerky and hesitant. It was ascertained that he had not lost consciousness when the shell exploded near him, but that he had received a terrible emotional shock. A piece of exploded shell had knocked off the head of a brother officer while he was talking to him, scattering blood and brains over his face. It was ascertained that he had suffered with chorea in early life, for this fact appeared in his Medical Sheet; inasmuch as the nature of his disease was stated to be chorea, the Pensions Board regarded the case as one of recurrent chorea and refused to grant any compensation. Eminent physicians who had seen him in France confirmed the

opinion I expressed, that this was not another attack of chorea, but choreiform movements brought about by shock; accordingly he received a liberal gratuity. This officer even after a year had not recovered emotional stability, and finally had to be boarded out as permanently unfit.

The Diagnosis of Hysterical Paralysis and Contractures

Since hysteria can simulate almost all forms of disease of the nervous system, it is always safer to approach the diagnosis of hysteria by exclusion; moreover, it cannot be too strongly insisted upon how frequent a functional motor or sensory disability may be combined with organic disease of the nervous system or with other affections, *e.g.*, of internal organs.

The hysterical patient will very probably give a history pointing to a constitutional neuropathic tendency. The history of the onset of the attack is of importance in the diagnosis. In functional paralysis or contractures the onset is sudden and complete and may appear immediately after the patient has recovered consciousness or after a period of meditation. The differential diagnosis of hysterical convulsive crises, which may be followed by or associated with mutism, deafness, paralysis or contractures is considered on p. 211.

In hemiplegia due to organic disease "flaccid paralysis," due to the effect of diaschisis, precedes the spastic condition; in functional paralysis of the flaccid type it remains flaccid and the spastic remains spastic.

Babinski has introduced the following valuable tests for the differential diagnosis of organic from functional hemiplegia.

(a) "Seize the paralysed arm, raise it, then allow it to fall, repeat several times this operation, each time attracting the patient's attention by talking to him. If you exercise a little patience in repeating the operation it will

be noticed that in the case of hysteria the arm will remain in position, without any support, for some little time; the paralysis has disappeared temporarily. This never happens in the case of organic hemiplegia."

(b) The tendon and osseous reflexes form part of a group of objective phenomena which the will is incapable of modifying; for this reason they are of the greatest importance in the differential diagnosis of the psycho-neuroses, simulation and organic disease, and to Babinski is due the credit of pointing out new methods of investigation of the reflexes, which we cannot do better than summarise.

The plantar extensor sign of Babinski may be described best in his own words.

1. "In general it is not only by the direction of the movement that the normal reflex differs from the pathological; more often extension is executed with more *slowness* than flexion; moreover, flexion is usually stronger when the internal part of the sole of the foot is excited than when the excitation is applied to the external, and the converse for that which concerns extension; finally, whilst flexion predominates in the two or three last toes, it is in the first or first two toes that extension is ordinarily most pronounced.

2. "The phenomena of the toes may present itself in early forms; that is to say, the plantar reflex may exhibit characters partly pathological, partly physiological. For example, in certain subjects the excitation of the sole of the foot provokes extension of the great toe or of the two first toes, and gives place at the same time to a flexion of the last toes; in others the toes are extended when the external parts of the sole is excited, yet in others whatever part of the sole is excited the plantar reflex is manifested sometimes by flexion, sometimes by extension of the toes; in the latter the first excitations generally yield flexion."

The technique is thus explained by Babinski.

"The muscles of the foot and leg must not be in a state of contraction, and it is well to tell the patient to look at the ceiling or to shut the eyes. The leg should be slightly flexed upon the thigh, and the foot should not rest upon

the bed by its external border, or be deprived of all support by the observer raising the leg. When the muscles appear to be relaxed the excitation of the sole can be made. The sole may be excited by stroking or pricking. The latter is necessary in some subjects in order to obtain a reflex movement of the toes. The excitation of the sole of the foot sometimes provokes a reflex abduction (fanning) of the toes. Both these signs point to an organic lesion causing degeneration of the pyramidal tracts."

In hemiplegia of organic origin Babinski has described a number of signs. Besides the above-mentioned *signs of the toe*, which occur on the paralysed side, are a number of other signs which serve to differentiate organic hemiplegia from functional, viz.—

1. Muscular hypotonicity, which may be thus demonstrated in the upper limb—

"If the forearm be placed in supination and a passive movement of it be made by flexion upon the arm, the two segments of the limb, forearm and upper arm can be approximated much more upon the paralysed than the non-paralysed side; this is termed exaggerated flexion of forearm upon arm."

2. Sign of the platysma—

"If the patient is made to open his mouth as widely as possible, sometimes when he flexes strongly the neck, the platysma muscle comes into view by longitudinal folds of the skin; these are not seen on the paralysed side."

3. Combined movement of flexions of the thigh and of the trunk in organic hemiplegia—

"The patient is made to lie quite flat on his back and told to fold his arms and raise himself, the paralysed limb is flexed at the hip and the heel is raised from the bed, whilst the opposite limb remains immobile, or is only slowly raised and less high; at the same time the shoulder of the normal side is carried forward."

4. Grip of the hand—

“If one glides the hand between the fingers and the palm of the paralysed patient and at the same time attempts to place it in a condition of extension, a resistance is experienced which gives the impression of an obstacle endowed with elasticity and sometimes animated by a slight trepidation. Moreover, whilst the hand is extended upon the forearm, the phalanges are flexed upon one another and upon the metacarpals and squeeze the hand of the observer. Babinski remarks that this gives rise to a characteristic ensemble of different perceptions to the observer that occur in organic hemiplegia as a rule, but never in hysterical hemiplegia.”

5. Sign of pronation; this can be obtained in organic hemiplegia before even contracture is established.

“The patient is told to allow the upper limbs to be quite inert, then the forearms are placed in a position of supination; they are supported at the wrist by their dorsal surface and several squeezes made; the hand of the hemiplegia side becomes pronated.”

A useful sign of organic disease is that of Oppenheim—

“In the normal condition when deep friction of the inner side of the leg below the knee is made, either there is no reflex of the toes or there is a plantar flexion. In cases of organic spastic hemiplegia or paraplegia, extension of the toes often occurs.”

It must be remembered that a spurious ankle clonus often occurs in hysteria, and all the deep reflexes may be exaggerated. Again, the abdominal reflexes may not be obtainable when there is much fat in the abdominal walls.

The sensory disturbances do not correspond to any spinal segmental or peripheral nerve distributions.

When either anæsthesia or analgesia exist the sensory disturbance often affects one half of the body and is, according to Babinski, the result of suggestion by the

method employed in testing sensibility. It does not exist in the meatus urinarius.

A stocking or gauntlet anæsthesia of the limbs is indicative of a functional sensory disturbance.

As the sensory disturbances are the result of suggestion, they are curable by contra-suggestion.

An important diagnostic sign is the response to treatment of functional cases, for should a cure not be obtained by electricity and persuasion, the patient is very possibly an exaggerator or simulator. When slight signs of organic disease are found, *e. g.*, the plantar extensor response, fanning of the toes, and Oppenheim's sign, together with absence of the abdominal reflexes associated with normal skin sensibility, the diagnosis of an organic lesion causing pyramidal tract degeneration is justified, although the paralysis, if absolute, may be mainly (if not entirely) of functional origin.

Long-standing cases of functional paraplegia with vasomotor, thermic, and secretory disturbances associated with disuse, atrophy of muscles and anæsthesia, following immediately shell shock and persisting for more than a year, may, to those unacquainted with such cases, be regarded as due to organic commotional lesions of the spinal cord of an hysterio-organic nature. The sphincters are not paralysed. The muscles may be wasted in the paralysed limb, but they react normally to the galvanic and faradic currents. The plantar cutaneous reflexes may be abolished in such cases, and yet the condition is one of functional paraplegia. Dejerine, Sollier and others explain the abolition of the cutaneous reflex by anæsthesia disturbing the reflex path. Other authorities, including Babinski, explain the absence of the plantar reflex by the hypothermia. I have seen several cases of this kind.

Differential Diagnosis of Peripheral Neuritis and Hysterical Paralysis

Generally speaking the diagnosis is easy. In neuritis there is (1) a diminution or abolition of the bone and tendon reflexes. (2) Muscular atrophy. (3) Complete or partial reaction of degeneration. (4) Hypotonicity of muscles. (5) The exclusive localisation of the motor disability and degenerative atrophy as well as disturbance of sensibility to areas corresponding to the anatomical distribution of one or several nerves.

Late Tetanus and Reflex Contracture

The following are the points given by Babinski for the recognition of localised tetanic contracture—

1. This contracture is intense; it cannot be modified by passive movements without causing acute pain, and it is difficult to modify it.

2. Paroxysmal extremely painful localised muscular spasms resembling those observed in normal tetanus. The cramp is sometimes preceded by pain in the scar of the wound.

3. Late tetanic contracture does not last more than two or three months.

Diagnosis of Functional and Organic Disease

The differential diagnosis of functional paralysis and contractures from paralysis and contractures due to organic disease, whether caused by concussion of the head or spine, or as a result of morbid processes, is not difficult, if a systematic examination is made. It is first necessary to point out that a paralysis or contracture associated with a slight lesion *may* not yield to treatment by physio-

psychotherapy. But is it necessary to assume with Babinski that the disability is due to spinal reflex action? May it not be explained by the wound acting as a constant source of suggestion of the idea of paralysis or contracture?

A gunshot wound of the head may cause a depressed fracture of the skull, or a penetrating wound with destruction of brain substance. If the lesion is on the same side as the paralysis or contracture it may be assumed that it has nothing to do with the paralysis or contracture of limbs of the opposite side; neither has it probably any connection with it, if the lesion is not in the region of the motor area. If it is in the motor area and affects only a portion of it, then it is unlikely that it will give rise to a complete and permanent hemiplegia affecting arm and leg. There may, however, be a monoplegia of either the leg or arm associated with a functional paralysis of the other limb.

Organic disease arising from arterial embolism or thrombosis, especially the latter, and due to syphilitic arteritis may occur, and, unless a careful physical examination be made, be mistaken for a functional condition with disastrous results. I have even seen a monoplegia due to cerebral tumour sent back with a diagnosis of functional monoplegia, and its treatment by hypnosis and suggestion attempted. It is only right to state, however, that only very few cases are sent over with a diagnosis of functional neurosis that are afterwards shown to be organic in origin. Early cases of general paralysis are sometimes sent over with a diagnosis of neurasthenia or shell shock, and occasionally cases are diagnosed as general paralysis upon clinical evidence, which upon further observation and examination of the blood and cerebro-spinal fluid are found not to be suffering with this organic disease. A few cases of amyotrophic lateral sclerosis, syringo-myelia and disseminated sclerosis are met with, and in most instances

these organic diseases have been correctly diagnosed. One difficulty which occasionally presents itself is the existence of miner's nystagmus, and this, associated with spurious clonus, exaggerated deep reflexes, and a functional paralysis and coarse tremor has led to the diagnosis of disseminated sclerosis. I always make it a rule to ask the occupation in cases of nystagmus, and when I find the patient is a miner I regard the cause of this symptom as being in all probability due to his occupation. Cases of tabes are occasionally seen; upon inquiry I have found a few instances in which men have been admitted to the army when suffering with lightning pains and girdle sensation; presumably these patients had at the time the characteristic pupil phenomena, although they were in the pre-ataxic stage. Such cases show the importance of examining the pupils in every case; for experience tells us how very rare it is not to find some pupil phenomena in syphilitic disease of the central nervous system, especially in tabes and general paralysis.

Gunshot wounds of the spine (including pieces of high-explosive shells or shrapnel) may without penetrating the theca vertebralis cause a focal hæmato-myelia; if this occurs in the cervical region a paraplegia may result with paralysis of the arms and wasting with R.D. of the muscles supplied by the cervical region of the cord. There is not much difficulty in deciding the organic nature of the paralysis in such cases. But occasionally a bullet may fracture a transverse process of a cervical vertebra, as in the following case. A machine-gun bullet fractured the transverse process of the seventh cervical vertebra; the patient was admitted with paralysis of the right arm and hand with loss of sensibility of the ulnar side of the hand and some wasting of the small muscles of the hand. There was also paralysis of the right leg with plantar extensor response. Recovery of power occurred both in the arm and leg after a short time. The extensor response

and some spasticity of the leg remained, indicating that there had been a contusion and degeneration of the pyramidal tract on that side. Later an aneurism of the common carotid occurred, and the artery was ligatured on the proximal side; a few days later the patient suffered with a pain in the head and a dazed condition, and this was followed the next day by a complete left-sided transitory hemiplegia. I presume a non-infective clot escaped into the anterior branch of the right middle cerebral artery, but as the arteries of the brain were healthy and the clot was non-infective, collateral circulation was restored, for the hemiplegia passed off and the young man was discharged some weeks later to his home. I have been unable to find out the subsequent history of this case.

Concussion of the spine (without visible injury) from the explosion of a large shell in a dug-out or other closed space causing hæmato-myelia is not infrequent (*vide* pp. 54–57), but attention to the physical signs and the history of the onset and its causation enables a correct diagnosis to be made. Occasionally, however, a man may have a large halo of functional paralysis superadded either to this condition or to that arising from gunshot wound. A man who has recovered from organic spastic paraplegia sufficiently to walk and stand without aid may from emotional shock suddenly lose the use of his legs, and the question naturally arises: Is this due to a lighting up of the old organic trouble, or is it purely functional?

Spinal rachialgia with curvature of functional origin (the French *plicature* or *camptocormie*) may arise as a result of spinal concussion, and the differential diagnosis of this from organic disease, from Pott's disease, and from concussion hæmato-myelia has to be made.

The Diagnosis of Contractures and Paralysis of Limbs following Injuries and Wounds

Contractures and paralyses arising as a result of wounds and injuries fall into three principal groups :—

(1) The paralysis or contracture entirely of functional origin, coming on immediately after the injury or after a short period of meditation; the wound serves as a constant source of suggestion of paralysis or contracture, and this is reinforced and firmly installed in the mind by immobilisation and disuse, till after a time arthritic and myogenic changes occur (*vide* Case, and Fig. 36).

(2) The paralysis or contracture is partially organic and due to injury of a nerve, but there is a large halo of functional disability which can, like (1), be cured by physio-psycho therapy (*vide* Fig. 46).

(3) The paralysis and contracture is entirely due to the nerve lesion (*vide* Fig. 53).

To make a differential diagnosis of the above three conditions a history of the injury and how it was subsequently treated should be ascertained, and for this purpose answers to the following questions should be obtained :—

(1) How soon after the injury did the present paralysis or contracture arise?

(2) Was it accompanied with loss of sensibility, and if so, what parts were insensitive?

(3) Has the paralysis or contracture extended or diminished since the injury?

(4) Was any operation performed for removal of the projectile, and was the nerve divided and sutured?

(5) Was the limb long immobilized on a splint?

(6) Did the patient suffer with tetanus and receive antitoxin injection? This should be asked in localised painful contracture following wounds.

Examination of Patient

An investigation of the wounds or cicatrices, their size, probable depth, situation and anatomical relation to nerves, should be noted. The scar of entry and exit of penetrating wounds should be considered in relation to the probable course of the projectile and the damage caused to anatomical structures. An X-ray picture may be necessary to ascer-



FIG. 53.—Ulnar paralysis following shrapnel wound of inner side of forearm. A little dark swelling painful neuroma is seen about the middle. The dark patch (painted) on the hand marks the anæsthetic area. The characteristic wasting of the small muscles of the hand and hyperflexion contraction of the ring and little fingers is seen; this is due to the fact that the ulnar supplies the two outer lumbricales muscles which are paralysed. The result is that the long flexors overcome the extensors more completely than in the case of the two other fingers, the lumbricales of which are supplied by the median.

tain whether the disability is in any way due to injury of joints or fracture of bones, or if there are fragments of metal left in the tissues, serving as a cause of irritation of a nerve. Voluntary and passive movements of the joints are to be tested; the latter may be done with the patient's eyes shut, telling him to repeat all the movements with the sound limb. The deep and superficial sensibility is tested. A gauntlet or stocking anæsthesia with a loss of the kinæsthetic and deep sensibility in a case of paralysis or contracture is indicative of a functional condition (*vide* Fig. 36).

If a plexus, for example the brachial or its cords, a

peripheral nerve such as the musculo-spiral, median, or ulnar, be injured, an anatomically characteristic paralysis and deformity will result, with a corresponding anatomically characteristic sensory anæsthesia (*vide* Areas of Sensory Nerve Distribution, Appendix). The deformity is due to atrophy of groups of muscles supplied by the injured nerve, and consequent overaction of opposing groups of muscles. The paralysis and atrophy is limited to the muscles supplied by the injured nerve (*vide* Table, p. 176), and these muscles either give the reaction of degeneration or fail to respond to Faradism or the condensor—unlike the muscles wasted from disuse, which respond to both normally. A knowledge of the motor points (*vide* Appendix) is necessary to test the electrical reactions of muscles, but the best method of testing the functional activity of a muscle is the physiological, which consists in feeling whether a muscle contracts when a person is told to perform a definite movement. A paralysis or contracture in excess of that which can be explained by the anatomical nervous supply of muscles is psychogenic in origin, or due to prolonged immobility with consequent arthritic and muscular changes.

Psychopathic Sensory Disturbances and Disabilities

The functional sensory psychopathic disturbances fall into two great groups.

1. Subjective. This group includes all those numerous and varied hysterical simulations of painful diseases of organs and structures arising from a "fixed idea" of pain localised or generalised in the body.

2. Objective. This group includes the functional anæsthesias, hypæthesias, analgesias, hypalgesias and hyperæsthesias affecting a more or less extensive surface of the body. It also includes the loss of deep sensibility, viz. the kinæsthetic sense of joints, muscles, tendons, and the bone sense of vibration.

The Psychopathic Sensory Disabilities

Since every structure and organ of the body is represented in the field of consciousness constituting the ego, it follows that if an "idea" of pain in a localised region is planted in the mind the idea tends to cause a conscious voluntary or involuntary reaction of defence. In recruits, conscripts and soldiers on active service, the conscious or subconscious wish to escape from an intolerable situation is fulfilled by an incapacitating localised pain which may arise by auto- or hetero-suggestion. The mind voluntarily or involuntarily responds to the pain by a defensive reaction, then by repercussion in the field of consciousness a vicious circle is established and a "fixed idea" of pain of central origin is installed. That the subconscious desire to escape from an intolerable situation is the essential cause of many of these topoalgias is shown by the frequency with which the lower limbs are affected by painful incapacitating conditions simulating organic diseases, such as sciatica, coxalgia, rachialgia and neuritis.

As the pain causing the disability is subjective, the difficulty always arises of deciding whether pain really exists at all, and whether the reaction disability is a voluntary simulation or not.

In judging whether there is conscious voluntary simulation or exaggeration we have to be guided by past conduct and present motives. Whereas the hysteric who is an unconscious simulator welcomes, even revels in, a thorough examination, the malingerer generally loathes it, and if the examination is searching he becomes resentful, sulky and complaining. The hysteric by his conduct shows that he is, in a great measure, unconscious of the unreality of his symptoms; the malingerer, on the other hand, conscious of the unreality of his symptoms, is suspicious and ill at ease.

In estimating the genuineness of pain without causal objective signs the facial expression should be watched,

the presence of local changes noted and alterations in attitude observed, remembering that the malingerer nearly always overacts his part. Finally, general or local disturbances of nutrition should be looked for.

The many and varied algias may arise apparently spontaneously as a subconscious "wish" fulfilment, or in consequence of suggestion in the form of a slight injury, such as a fall, a blow or a wound. Again, inoculation, rheumatism, fever and trench feet may by suggestion become the basis of a "fixed idea" of pain with a corresponding defence reaction, and thereby a means of escape from military service.

A soldier at the front may receive a slight shrapnel or gunshot wound, or be blown up by a shell, causing a contusion of the spine or of one of the large joints; and his attention is concentrated on the injured part by the pain. This pain persists as an "idea" in fulfilment of a conscious or subconscious wish to be sent to the base (*vide* p. 133).

PSEUDO-ARTHRITIS.—In the upper limb the shoulder is the joint most frequently complained of as being painful on movement; the elbow and wrist seldom. The joints of the lower extremity are the most often complained of, especially the hip, giving rise to a pseudo-coxalgia. The sacro-iliac joint is not infrequently the seat of pain. Radiography usually shows no affection of the joint, but sometimes the symptoms have been suggested by a previous organic lesion. The treatment which in the past has been adopted for this trouble has fixed in the mind the idea of an incurable disease.

Spinal rachialgia is not at all uncommon; the pain is diffuse and not localised, and the whole spine is tender, more or less; the patient, open to suggestion, can easily be induced to shift the painful spot. Thus, I had a man who said he was unable to walk because of the pain in the spine. I sat behind him and told him to tell me the

exact spot where he felt the pain; he localised it at the end of the spine. I said to an officer who was with me: "He is four inches below the end of the spinal cord." I then talked to him upon another matter and again tried, and he had shifted the painful spot four inches higher. I again suggested that it was too low: "It should be between the shoulder blades." Again, after a little while, he accommodated the painful spot to my suggestion. I then told him that there was nothing wrong with the spine and he had better get up, put away his sticks and walk; which he did.

As a rule the pains in these psycho-sensory algias do not conform to segmental root distribution (*vide* Table, p 176), nor to the course and anatomical distribution of peripheral nerves (*vide* Sensory Nerve Areas, Appendix); they are not found at points of emergence of nerves from bones; the pains are mobile, and particularly open to change of situation by suggestion; they rapidly disappear with electro-psychotherapy.

The Anæsthesias, Analgesias, Hyperæsthesias

The objective alterations of sensibility in the war psycho-neuroses are much less important than those of subjective sensibility. They do not cause any functional disability, in fact the patient is unaware of the existence of any sensory disturbance until it is suggested by examination; they are therefore not a cause of evacuation; they are usually associated with some motor functional disability, such as hemiplegia, other varieties of paralysis, tremors and convulsive hysterical crises, and they are discovered during the course of examination. Loss of sensibility to pricking or touch tested by cotton wool may extend over extensive areas of the body; thus there may be a stocking anæsthesia of the legs or gauntlet anæsthesia of upper limbs. There may be a complete hemianæsthesia, but pricking of the urethral orifice elicits pain on both

sides. The cutaneous reflexes are present and normal. All these objective sensory disturbances are due either to auto-suggestion or hetero-suggestion, generally by the doctor, who tests cutaneous sensibility by asking the patient if he feels the prick of a needle. This suggests to the patient that he is not expected to feel. As Babinski points out, the proper method of testing is to make the patient point, with his eyes shut, to the spot pricked or touched. All these sensory symptoms in the hysteric can generally be removed at one sitting by the faradic brush and counter-suggestion.

Loss of Bone Sensibility and of the Kinæsthetic Sense

In many cases of hysterical paralysis there is a loss of sense of movement and of position of the joints. This may be tested by telling the patient to close his eyes and follow in the sound limb the changes of position made by passive movements of the paralysed limb. The bone sensibility is tested by the vibrating tuning-fork placed upon the bones. The sensibility of the bones to this stimulus is lost in conjunction with the loss of the kinæsthetic sense. The muscles nevertheless, although atrophied by disuse, respond to faradism (*vide* Case, p. 145).

Reflex Reaction in Relation to Hysteria and Malingering

The cutaneous reflexes are diminished or abolished according to the presence of anæsthesia or hypæsthesia (Oppenheim). According to Chavigny, in the majority of instances of hysterical anæsthesia the "tickling" reflexes (when these reflexes originate in the anæsthetic areas) are abolished, whereas reflexes termed organic are still retained in spite of anæsthesia at their "starting-point." It has been stated that malingerers, as evidence of anæsthesia, are able to suppress the plantar reflex of one side, or with

the same end in view exaggerate the reflexes on the opposite side. Moreover, according to Teissier, a dissociation of reflexes may occur in hysteria, viz. abolition of the plantar with exaggeration of the patellar reflex. It is well known that Babinski's sign is one of real importance in the detection of organic disease as opposed to functional. But it is well to point out that if all the toes are extended no inference can be drawn with certainty; also that a simulator by practice can (upon gentle stroking of the plantar surface of the ball of the great toe and internal half of the heel) produce dorsal extension of the great toe.

Psycho-Sensorial Affections

Never before have the special senses of sight and hearing in vast numbers of human beings been subjected to the same intense and prolonged excitation accompanied by emotional disturbances, especially in the case of hearing, as during this war.

A man was sent down from the clearing station on February 10th, 1916; he had been blown up and buried; he was blind, deaf, and mute. He was sent from the St. John Ambulance Hospital, France, to the 4th London, and admitted on February 29th. When I saw him he was lying in bed on his side, with his legs curled up. He took no notice of any sounds however loud, he did not speak, and he could not see. This was the condition noted when in hospital in France. When I examined him he could be made to open his eyes, and it was found that the pupils reacted to light; he took no notice of a strong light, nor did he reflexly close the eyes when a blow was suddenly aimed at the face. The slightest touch on the face, however, aroused an immediate defensive movement or withdrawal of the part. It was difficult to test the reflexes, but I failed to obtain any deep reflexes of the lower extremity, and I could not obtain a plantar response. I saw him fed with milk; at first he resented the nozzle of the feeder touching his lips, but as soon as the milk entered his mouth he swallowed it. I understand there has been no difficulty in feeding him. He responds to the calls of nature, and does not wet the bed. He is even more sensitive and apprehensive to touch than the deaf-mute, who also showed fear of being injured when touched.

The next day while suffering from the pain of an enema, which was relieving the bowels, he somewhat suddenly regained his sight. He looked around in a bewildered manner, then burst into tears. The next day he was able to write. His powers of recognition were good, but he had a complete gap in his memory of the whole time he was in France. With the recovery of sight the skin hyperæsthesia disappeared. There was still a bewildered blank expression of the countenance, but he was able to tell us where his home was, how many brothers and sisters he had, their names and ages, as well as other information except his experiences in France. Two days later he had a sort of hysterical fit and recovered his speech and hearing. The next day I saw him he greeted me with a happy expression of the face, and I congratulated him upon his recovery. He was able to converse upon most subjects, but there was still a complete loss of power of recollection of all that had happened in France.

This blind deaf-mute, then, was for a time conscious of the external world only by tactile and kinæsthetic perceptual impressions, consequently the mind was focussed on them in his life of external relation. Owing to the effect of past terrifying experiences constantly revived in dreams and very possibly, being blind, by hallucinations, his mind was constantly suffused with fear and apprehension of danger, hence the protective reactions of withdrawal of a part touched were greatly exaggerated.

"Severe Shell Shock." Functional Deaf-mutism following Barany Experiment; "Terrifying Dreams"; Pantomime of Bayoneting in Sleep; Sudden Recovery of Hearing and Speech, with Severe Mental Disturbance.

A deaf-mute was admitted under my care; he displayed extreme apprehension of being touched in any part of his body. Although quite unable to hear any sound or produce any audible sound, he was able to write a lucid account of his experiences. He told me that he was at Gallipoli, and that while in the trenches a big shell fired by one of our monitors fell short into the trench he was in, and he lost consciousness. When he came to, he was neither deaf nor speechless, but in the Canadian hospital the doctors had syringed his ears with hot and cold water, and he became deaf and dumb. This man had terrifying dreams of trench warfare; he had had a slight wound of the right arm, which he continually felt, and he was most apprehensive of being touched on it or any part of his body. Captain Brown, at my request, hypnotised him,

but it did not restore his hearing and speech. I suggested that his speech would come back to him on a certain day, and, although this did not happen yet he began to whisper the vowel sounds and whisper words of one syllable. I assured him it would come back, and every day he greeted me with the thumbs up. During the several months this man has been in the hospital, he has on many occasions been observed to sit up in bed, look under the bed, first on one side, then on the other, then perform the pantomime of bayoneting the enemy. Of this he has no recollection. On March 10th he had a kind of hysterical fit, and Dr. Ash, in the absence of Captain Brown, was summoned. A little later it was found that he could both hear and speak. I saw him the next day; he greeted me with a joyful face and thanked me. Curiously, he had lost his recollection of having written down that he had lost his speech after the treatment in the hospital, and he said he remembered nothing about the incident, although he told us again that the monitor had dropped a shell in the trench that he was in. All the hyperæsthesia had now disappeared; he no longer instinctively shrank away from being touched.

It is remarkable to note that these two cases illustrate in an extreme degree, in the form of an hysterical fit, the mental shock that often precedes or accompanies the restoration of the functions of hearing and speech. When this does not happen it is not uncommon to find the patient complaining of headache or dizziness following or preceding the restoration of function.

It is not surprising, therefore, to find deafness and deaf-mutism appearing as a result of shell shock. Less frequent, but still not very infrequent, are the cases of blindness, and occasionally both senses are lost. These psycho-sensorial affections were almost unknown before the war; likewise mutism, which has already been very fully considered in another chapter. Loss of taste and smell are very rarely met with.

Deafness

Deafness and deaf-mutism are a very common result of shell shock. They are due to a psychogenic disturbance causing cortical dissociation in the centres of hearing. As

hearing is the primary incitation to speech, it is probable that dissociation of the auditory perceptor centres causes the mutism; for recovery of hearing is followed by, and immediately associated with, recovery of speech. The patient affected with psycho-sensorial deafness or blindness rarely shows any serious visible external injury.

The organic lesions, caused by "windage," of the eyes and ear have already been discussed when considering commotional shock (*vide* pp. 74-76). But functional affections of the special senses, especially deafness and deaf-mutism, form part of the clinical syndrome of shell shock in a considerable percentage of cases. When the patient recovers consciousness from shell shock and is perhaps wandering or sitting in a dazed condition, it is found by the stretcher-bearers that he does not reply to questions, nor can the doctor at the C.C.S. obtain any answer. Possibly, however, when taken by surprise and suddenly told to put out his tongue or shut his eyes, he obeys, but later no response is obtained. This functional deafness may be partial, or completely affect one ear or both ears; it is more likely to occur if the man has previously suffered with organic disease of the ear. The patient complains of tinnitus in the form of banging, booming and singing in the ears. Unlike organic disease of the ear, the patient with functional deafness is able to modulate the loudness or pitch of the voice. I have had cases which came under my care who had been absolutely deaf many months and the disability has produced noticeable depression, which disappeared almost immediately after they were cured by physio-psychotherapy. Hysterical deafness is usually complete to all sounds. The tuning-forks applied to the bone are not heard. In fact the deafness from cortical dissociation is absolute, and in that respect differs from deafness due to organic disease.

Hyperacusis or extreme sensibility to sound is more common than hypacusis; it is a very common and

troublesome symptom giving rise to the "starting reflex," and often makes the patient suffering with shell shock or war neurosis apprehensive and miserable, and this excites and aggravates the headache.

Vision

The organic changes met with in ophthalmic practice have already been discussed on pp. 71-73.

Shortly after shell shock the patient may complain of blurred vision or as if everything were seen through smoked glass. The blindness may come on after a period of "meditation," and persist, as in this case, for months.

Sergeant L—, age 29, joined in 1915. Before he was in the army he lost his left eye; it had to be inucleated in consequence of an injury caused by a nail flying up into it while hammering. The history he gives of his loss of sight is typical. He is in the A.S.C., and was taking up a train with 9·2 ammunition in December 1918 when the Germans fired shells at it, one of them hitting the train and exploding the ammunition. He was blown up and picked up unconscious. He could see indistinctly: "everything looked hazy." After a few days (period of meditation) he was completely blind, except for the power of telling light from darkness. *The pupil reacts very briskly to light and upon convergence.* The fundus is normal. The hands are clammy; he has an anxious, worn, rather mask-like expression, but complains of no symptoms beyond his loss of vision.

He made a complete recovery by physio-psychotherapy.

Another case under my care was of interest. A shell burst near a man while he was attending to a wounded comrade. He managed to drag the wounded man into a culvert, but then found he was quite unable to see. Another wounded man came into the culvert and helped him to get out. The emotional shock was the primary cause of the blindness, but it did not come on till the darkness of the culvert suggested it.

Failure of accommodation (asthenopia) is not infrequent in war neurosis, especially in neurasthenia. It may be

weeks before the patient is able to read large print, or the patient is readily fatigued and the print becomes blurred. Macropsy and micropsy are occasionally met with. An instance of the former condition occurred in a Canadian officer under my care; he told me that the cartridges of his bandolier looked as large as pom-poms. Photophobia is common, but usually this is due to the action of irritant gases; photophobia is often associated with blepharospasm (*vide* Fig. 51). Hysterical monocular diplopia occasionally occurs.

Sphincter Affections

Reference has already been made to the fact that retention of urine frequently follows shell shock. Incontinence of urine is a not infrequent manifestation of hysteria in soldiers. As a result of fear a soldier passes urine involuntarily, wets his breeches and wets his bed; he becomes an object of derision by his comrades, which adds to his disability; the involuntary act becomes firmly installed as a habit. Nocturnal emissions which the individual had suffered with in early life may return in conscripts, and owing to the nuisance caused to others, lead to their discharge. Hysterical anuria may be dismissed, as it does not occur. The cases which were formerly described are now recognised as being deceptions.

Neurasthenic Signs and Symptoms

Whereas hysterical signs and symptoms are common in soldiers and non-commissioned officers they are comparatively infrequent in officers; and the great majority of officers invalided home for functional nervous disease are suffering with neurasthenia arising from various causes incidental to modern warfare. The signs and symptoms of neurasthenia from which they suffer differ in no essential from those which affected men in times of peace, except in two or three important respects, viz. (1) Prolonged

stress of war with responsibility leading more often to an acquired condition of neurasthenia. (2) Sexual functions playing a far less important *rôle* in the production of fatigability and irritability of the nervous system. (3) The subconscious mind as shown by the persistent terrifying dreams exercising a pronounced reminiscent fear effect.

SYMPTOMATOLOGY.—Every organ and structure in the body is represented in consciousness, but happy is the individual who is oblivious of the functions of the organs of digestion, circulation and respiration; for, if the mind dwells upon these organic functions, their normal automatic action is disturbed, discomfort and pain result, which, reacting back upon consciousness, add to the mental apprehension and a vicious circle is soon established.

Lassitude, weariness and fatigue are protective subjective feelings, that own no visible objective cause, and are due in great measure to exhaustion of the neural elements. They impose a desire for rest of the mind and repose of the body, by which a recuperation of neural energy may take place.

The subjective symptoms of neurasthenia are numerous and diverse. The objective signs are few in comparison and relatively unimportant. The symptoms will now be considered in detail.

HEADACHE.—This symptom is almost invariably present; in the early stages it is severe and constant with exacerbations; as the patient improves in general health, particularly after natural sleep has returned, the headache diminishes in severity and constancy. The character and site of the pain varies in different individuals. Some complain of a dull aching diffuse pain, others of a splitting, bursting feeling or of a tight band; sometimes the pain is boring or lancinating. It does not necessarily affect the whole cranium, as it may be localised to the forehead, the temples, the back of the eyes, the occiput, the *en casque* of Charcot. The patients often complain of a feeling of emptiness, of muzziness, of fulness, of pressure, or of constriction of

the head. After a sleepless night, or one disturbed by terrifying dreams, the patients complain of headache in the morning, which tends to pass off during the day. Emotional disturbances of any kind are apt to be followed by, or associated with, exacerbations of cephalalgia.

Not infrequently there is hyperæsthesia of the scalp, and cases occur in which there is hyperæsthesia of the neck and stiffness, a condition which might with other symptoms make one suspect cerebro-spinal meningitis.

SPINAL HYPERÆSTHESIA AND RACHIALGIA.—The hyperæsthesia may be localised or diffuse; the patient may complain of a burning sensation, of numbness and tingling radiating into the buttocks and down the upper part of the lower limbs; he may state that he suffers with various sensations in the spine which, although not neuralgic in character, are often increased by pressure, movements of the spine, or prolonged standing or walking. Upon examination of the spine no objective signs can be found, but sometimes over this area there may be tenderness on pressure. The subjective feelings may be continuous, intermittent or transitory.

Associated with this spinal hyperæsthesia there may be a feeling of weakness or heaviness in the lower extremities which may simulate an oncoming paraplegia, due to meningo-myelitis; likewise the pain and paræsthesia may induce in a syphilitic the fear of locomotor-ataxy. Pains in the thorax may simulate pleurisy, and neuritis may be feared in various situations on account of these subjective feelings, but there is neither tenderness on deep pressure of the limbs nor are the nerves painful on compression.

Spinal neurasthenic symptoms I have seen much more frequently in recruits sent to me for an opinion than in soldiers and officers returned from the front.

INSOMNIA.—Loss of the habit of sleep and fatigue conspire in producing one of the most frequent, persistent

and baneful symptoms of irritable nervous weakness in soldiers who have been exposed to the prolonged stress of war. There is weariness and desire to sleep, but if the patient dozes off it is only to live over again the terrible experiences he has gone through; often he is awake till the early hours of the morning, or he complains of awakening at an early hour and of being unable to fall asleep again. The important influence of dreams has already been fully discussed.

Insomnia often leads to the habit of taking drugs to induce sleep; they may be necessary, but great care should be taken to avoid the drug habit and endeavours should always be made to restore natural sleep which alone can lead to recuperation of an exhausted nervous system.

MUSCULAR WEAKNESS.—Not only is the neurasthenic patient incapable of any sustained mental effort, but bodily fatigue on exertion is a constant symptom. There is no wasting of muscles and no alteration of the electrical excitability; the deep reflexes are usually exaggerated, but not modified otherwise. A fine rhythmical vibratile tremor of the fingers in the outstretched hand is nearly always present (9–10 per sec.), like that met with in Grave's disease; in fact, about 10 per cent. of cases of shell-shock neurasthenia exhibit mild signs of this endocrine affection. The tongue or lips may show tremor, and cause, or be associated with, some speech embarrassment. A vibratile tremor of the orbicularis oculi is very frequently present.

VERTIGO.—Dizziness, due to exhaustion of the cortical centres, is a constant and troublesome symptom. The patient usually complains of a feeling at times of instability when he assumes an erect attitude; or it affects him often when he is crossing a thoroughfare. Less often, this feeling of giddiness is more or less continuous; it may be associated with tinnitus (*vide* p. 186).

VISUAL AND AUDITORY SENSORY DISTURBANCES (*vide* pp. 185–87).

VISCERAL-VASCULAR SYMPTOMS.—Among the most important symptoms of neurasthenia are those related to the viscero-vascular functions; for they may simulate closely many serious organic diseases. Of these the most important and most common are the *Cardio-Vascular* symptoms.

CARDIO-VASCULAR.—Very numerous are the cases of neurasthenia with cardiac symptoms which are designated D.A.H. (disordered action of the heart), and not a few V.D.H. (valvular disease of the heart).

The term "irritable heart" is also used, especially when symptoms arise after muscular exertion. Functional disorders of the heart occurring in the subjects of neurasthenia are very common in recruits and conscripts; it is therefore not to be wondered at that a number of soldiers and officers returned from the front suffering with neurasthenia complain of palpitation, precordial pain and anxiety. Examination shows that there is rapid action of the heart increased upon slight exertion, and particularly by emotional disturbance or apprehension; there may be some evidence of dilatation, the cardiac dulness extending to the nipple line; the apex beat may be diffused over an area the size of a crown piece and a soft systolic murmur may be heard at the apex which is not conducted into the axilla. Although the heart-beat is much more frequent than normal, the pressure is not appreciably raised and is sometimes lower than normal.¹

¹ A series of observations upon blood pressure in cases of Shell Shock and War Neurosis under my care have led to conflicting results. The earlier series made by Dr. Edith Green showed a greater number of cases with a low blood pressure, while later observations made by Lieut. Huddleston, A.M.S., showed a preponderance of cases with a high blood pressure or pressure above normal. As I have no reason to doubt the accuracy of the methods employed I am of opinion that the type of cases was not proportionally the same in the two series. This explanation is all the more probable since Dr. P. Bousfield ("On the Relation of Blood Pressure to the Psychoneuroses," *The Practitioner*, November 1918) concludes from a series of observations that in a pure neurasthenia, unless complicated by organic disease, the blood pressure is usually subnormal. In a hysteria it is generally normal, in an anxiety neurosis it is more often than not considerably above normal.

The pulse-rate is usually increased, and it may be as rapid as 150; sometimes it is slow and arhythmic; and cases of slow pulse and feeble heart action, according to Lewis, are more likely to suffer with an attack of syncope when undergoing training exercises than cases of tachycardia.

Lewis thus describes these attacks :—

“The syncopal attack may be preceded by a short interval of giddiness, by a severe weakness or unsteadiness. Consciousness is lost and the fall is sudden, but rarely heavy. Pallor and sweating are present. Involuntary movements are slight, and usually confined to the face and arms; a general rigidity may be developed, the tongue is not bitten, neither is the urine passed. Nausea or vomiting may be present. The attack lasts for a few minutes and is followed by lassitude and headache. A history of earlier attacks is common; these are associated usually with emotion, *e.g.* at sight of blood, also with long standing at attention, or the cessation of sudden effort; they do not occur in recumbency.” This description of Lewis is quoted in full, for unless it were known that such attacks may occur and that nevertheless a man suffering with them is able, according to Lewis, to return to drill after forty-eight hours, it might be thought that the patient was suffering with epilepsy, or, if they occurred in a man of over forty, that it was Stokes-Adams’ disease.

In some cases of cardiac neurasthenia the patients may suffer with attacks of pseudo-angina, the symptoms being a feeling of suffocation, anxiety and precordial pain radiating down the left arm. Enfeeblement of the heart’s action with coldness of the hands and feet may also occur, or the pulse may become slow and arhythmic.

These cardio-vascular symptoms may be associated with respiratory difficulties simulating an asthmatic attack. Emotional disturbances are often accompanied by paroxysms of rapid breathing. Again, a man who has

suffered with gas poisoning may have a reminiscence of the difficulty of breathing resulting in paroxysmal dyspnoea. Emotionalism may even show itself in the control of breath in speech.

The vaso-motor disturbances of neurasthenia are either



FIG. 54.—Median nerve paralysis. The insensitive area shows an acrocyanosis which contrasts with the intact sensory area of ulnar distribution.

due to arterial spasm, manifested by coldness (hypothermia) and blueness of the extremities (acro-cyanosis, *vide* Figs. 54, 55); or to vaso-dilation, causing a feeling of rushing of blood to the head, flushing and blushing and a fear of the same erythrophobia. Sometimes a factitious urticaria occurs.

SECRETORY.—Hyperidrosis may be general or local, and especially common is a condition of sweating palms of the hands.

GASTRO-INTESTINAL.—Symptoms of gastro-intestinal disorders are not at all uncommon. A very frequent condition is gastro-intestinal muscular atony, causing digestive disturbances and constipation; the patient complains of pains at the epigastrium relieved by food, but the digestion is slow and laborious, often accompanied by hyperacidity and pyrosis; “hunger pains” are not infrequent in these cases. Owing to the muscular atony, dilatation of the stomach and secondary fermentation arises. Sometimes acute crises of pain accompanied by vomiting may simulate the crises of tabes.

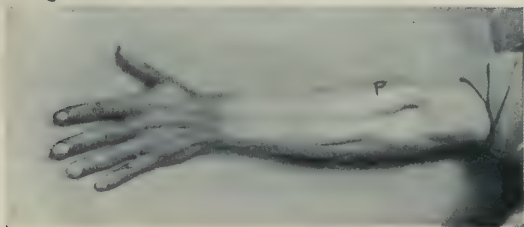


FIG. 55.—Acro-cyanosis of neurasthenia.

In severe cases anorexia, vomiting, diarrhoea, pallor, depression and even cachexia may supervene, causing gastric ulcer, duodenal ulcer, or even malignant disease to be suspected. When the vomiting is persistent and accompanied by severe headache, cerebral tumour or abscess may be considered as possible. A bismuth meal followed by X-ray examination will help to exclude the former; the absence of optic neuritis will serve in the differential diagnosis from the latter.

The intestinal symptoms are irregularity of the bowels, obstinate constipation or diarrhoea, and sometimes a mucous colitis with passage of casts. These intestinal

symptoms of neurasthenia may occur in a patient who has previously suffered with dysentery, and this makes the diagnosis more difficult. Again, a neurasthenic who has suffered with appendicitis and who has had the appendix removed is liable to suffer with reminiscent intestinal symptoms.

GENITO-URINARY SYMPTOMS.—Sexual neurasthenia is not so common in soldiers as in civilians. Still, a history of masturbation may be elicited causing an irritable weakness which may be associated with various disorders of the genital organs, *e. g.* the patient may complain of erection and nocturnal emissions, spontaneous emissions without erection, erections without emissions, incomplete coitus owing to ejaculation almost immediately, or to ejaculation without erection. Coitus in the neurasthenic is generally followed by lassitude and fatigue, or, as frequently happens in the neurasthenic soldier, there is a loss of sexual desire. There may be frequent desire to micturate; the urine is pale, of low specific gravity, containing a diminished quantity of urea, excess of phosphates and often a deposit of oxalate crystals. Nocturnal enuresis occasionally occurs.

THE MENTAL STATE.—The patient is easily tired by any mental effort; he is unable to concentrate his attention. The intellectual faculties are not seriously affected, although the patient may complain of failing memory, especially of recent events. If there is any lack of comprehension, it is through lack of power of attention. The patient is often self-centred and introspective, but there is no perversion or any loss of the mental faculties. His reasoning and judgment may, however, be capricious and uncertain; indeed, loss of will-power and irresolution in acting, owing to the fear of doing the wrong thing, makes the neurasthenic officer fearful of responsibility and incapable of carrying on. The desire to "carry on" and not be considered a shirker and the feeling of inability to do so is a

constant source of anxiety causing insomnia and further neural exhaustion, from which the sufferer may obtain no relief when he is sent home—for too often the mental conflict continues.

Hypochondriasis and various morbid fears indicative of an obsessional psychasthenia are not uncommon, *vide* p. 205. It is of great importance to gain the full confidence of the patient by making a thorough examination in these cases of visceral neurosis the better to be able to assure them that their organs are not diseased and that the symptoms they are suffering from, and which alarm them, are due to nervous exhaustion and apprehension.

Diagnosis.—A careful physical examination in order to exclude those organic diseases which are accompanied by the same or similar subjective symptoms will generally permit a correct diagnosis to be made. It is necessary to call attention to the fact that a neurasthenic may suffer from organic disease, although as a rule organic disease in soldiers is not to be expected, as they would not have been admitted into the army in such case.

It must be remembered, however, that a number of organic diseases may come on after admission to the army, and one of the most frequent is phthisis; and in the early stages of this disease subjective symptoms suggesting neurasthenia may occur, *viz.* palpitation, feeling of weakness, irritability, tiredness and a tendency to perspire unduly. Again, organic disease of the heart and arteriosclerosis have to be excluded in neurasthenia with cardiovascular symptoms.

The diseases of the nervous system which may be mistaken for neurasthenia, are : (1) Paralytic dementia, especially in the early stages, with depression. (2) Tumour cerebri. (3) Tabes in the preataxic stage. (4) Cerebral syphilis. (5) Cerebro-spinal syphilis. (6) Cerebral abscess or encephalitis. (7) Disseminated sclerosis. (8) Various forms of toxic neuritis. (9) Chronic alcoholism. (10)

Fractures and head injuries with or without associated neurasthenic symptoms.

It is unnecessary to refer at length to the objective signs of these diseases, one or more of which are invariably present and serve as a means of differential diagnosis from a purely functional affection of the nervous system. Among the more important are pupil phenomena, changes in the fundus oculi, modifications of the superficial and deep reflexes; and the presence of any one of these will suffice to indicate that there is an organic disease. Examination of the blood and cerebro-spinal fluid should be made in doubtful cases; and in cases of concussion or shell shock examination of the head and spine by X-ray for injury, or depressed fracture, should be made when organic signs are observed, or the history points to the possibility of injury even when there is no visible external evidence of it. I have seen cases diagnosed neurasthenia, in which an X-ray examination has demonstrated fracture; especially is this likely to occur in the frontal region, owing to the fact that the frontal lobes may be injured without giving rise to well-defined cerebral symptoms. It must always be remembered, however, that trauma may be associated with neurasthenia and, if not the sole causative factor, is an important contributory cause; especially is this the case in neurasthenia following shell shock, for although there may be neither visible external evidence of injury to the head or spine, nor any gross nervous signs of organic disease, such as paralysis or irritation phenomena, nevertheless, the higher functions of the brain may have been profoundly affected. A further proof that *commotio cerebri* has produced an effect upon the higher cerebral centres is afforded by the fact that alcohol has a more toxic effect.

The subjects of concussion or shell shock are in an emotive state, and just as in civil life we know that legal intervention for the payment of claims under the

Employers' Liability Act have led to deserving cases being subjected to prolonged worry, anxiety, sleeplessness and aggravation of the neurasthenic symptoms, so also cases of intensification of the symptoms are met with in soldiers and officers when their claims are hung up on account of the conflicting findings of Medical Boards.

Course and Progress of the Psycho-neuroses

The hysterical symptoms, mutism, aphonia, stammering, the spasms, ties, choreiform movements and the various forms of contractures and paralysis previously related, are often associated with symptoms of neurasthenia. The hysterical manifestations can be removed by contra-suggestion (*vide* p. 272-4) at once, but the neurasthenic symptoms persist for months; and it may be safely said that few cases of neurasthenia following shell shock or prolonged stress of war are fit for active service for at least six months, and many not for twelve months.

The question arises whether patients suffering with severe symptoms, who after two months' hospital treatment are still haunted by terrifying dreams, would not do much better if they were permitted to return to civil life for a period of not less than six months, when they should be called up again. Many of these patients become hospitalised, and continual contact with others suffering with anxiety-neurosis does not conduce to an atmosphere of cure, which is one of the essentials in the treatment of psycho-neuroses. The atmosphere of cure, however, largely depends upon the administration, and nothing is more beneficial in the successful treatment of these functional nervous cases than the object-lesson of cure in long-standing cases of mutism, deafness, blindness, and of various paralyses, that for months had resisted treatment. As Charcot truly said, "C'est la foi qui sauve ou qui guérit," and although faith has not the same influence in the cure

of neurasthenia as it has in hysteria, nevertheless it is only by faith in the treatment that the mind will find relief, and that the anxiety, which perpetually keeps up the exhaustion of the neural energy, will be allayed. It is only by faith in the doctor's examination and the assurance given to the patient that there is no organic disease and that he will get perfectly well, that the mind can be led away from dwelling upon and thereby increasing a disordered visceral function. The vicious circle between the anxious mind and the upset organ is broken by the faith which thrusts the idea out of consciousness and permits the organ to resume its normal unnoticed automatic action.

The Psychoses of War

Contrary to popular belief, there are no new clinical types of mental disease in soldiers. There are no "war psychoses." The clinical pictures, symptomatology and prognosis of the psychoses are the same in soldiers as those met with in civilians, the only modification being the coloration of the hallucinations, the illusions and the delusions by war experiences.

In the majority of the cases of psychosis the war has only revealed, excited, or accelerated, and not caused the disease. Under the normal conditions of civil life the potentially insane individual may not be sufficiently anti-social to need restraint, but with the stress of war, and the necessity of conforming to military discipline and duty, his mental instability not only becomes apparent, but is a source of danger to himself and others; consequently evacuation as a rule is followed by discharge from the army.

Still, there must be a considerable number of soldiers evacuated from the front suffering with only transitory mental symptoms, for 20 per cent. of the cases admitted

to D. Block, Netley, labelled "Mental" are sent on to neurological hospitals. A number of cases have been admitted under my care with the diagnosis of "mental" and upon arrival these had already recovered from any signs of mental disease and have been treated in the general wards.

The Psychoses

In a conscript army there are all grades of mental stability, from the absolutely sound mind, in the sound body, to the unsound mind. No combination of extrinsic factors can in most of the former produce a mental instability. Head injury, emotional and physical shock, prolonged stress of war, and fever are insufficient; whereas in the unsound mind any one factor may suffice to reveal, to excite or accelerate a mental disorder (psychosis). Between the two ends of the scale are all grades of mental stability.

Dupré gives the following useful classification of the subjective signs and objective symptoms of the two primitive states, nervous exhaustion and emotivity.

PSYCHO- NEURASTHENIA (constitutional or acquired).	Subjective symptoms.	<i>Headache. Rachialgia, malaise. Vertigo. Sensorial hyperaesthesia. Accommodative asthenopia.</i> <i>Slowing and enfeeblement of intellectual operations. Easily fatigued by mental or bodily efforts. Amyosthenia.</i> <i>Painful feeling of fatigue, of powerlessness, of weariness. Alternate periods of excitement and depression; disorders of temper and character.</i>
	Objective signs.	<i>Insomnia.</i> <i>Digestive troubles with emaciation, denutrition.</i> <i>Tachycardia, hypotension, tendency to hypothermia.</i> <i>Fatigability (reaction times increased—disorders of gait and station).</i>

PSYCHO-NEUROSIS
EMOTIVE
(constitutional
or acquired).

Subjective
symptoms.

Impressionability by effective hyper-reflectivity in the sense of excitation or inhibition.

Terror, timidity; continued and paroxysmal anxiety, diffuse or localised. Obsessions, phobias, doubts and scruples, etc.

Irascibility.

Various disorders of *psycho-sexuality*.

Objective
signs.

Sensory-motor erethisms exhibited by hyper-reflectivity of tendons, cutaneous and sensorial, of non-organic character.

Motor disequilibrium: tremors, visceral spasms, palpitations; tachycardia, often permanent and variable.

Vaso-motor disequilibrium: blushing, pallors, dermatographism.

Glandular disequilibrium: crises, episodic-spontaneous or provoked inversions of secretions, urinary, sweating, intestinal, salivary, lachrymal.

Pharmacodynamic disequilibrium.

"These two states can, by their exaggeration, episodic or continuous, terminate in delirious psychopathic syndromes; psycho-neurasthenia to different forms of mental confusion; morbid emotivity to anxiety psychopathies. The frequent association of the two primitive states (neurasthenia and emotivity) is often then reflected in the combination of secondary syndromes; confusion with anxiety. Morbid emotivity assumes sometimes a special form characterised by the electivity of anxiety-reactions towards events or situations of the war, particularly explosions, risks of assaults, of bombardments. The emotive state is manifested in soldiers in the form of irresistible fear of dangers of war, associated with crises of anxiety and terror at the front, impulsions and frequently desertion from post of duty.

"These acute or subacute states, very varied in their forms, their associations, their evolution, their duration, can at the end of some months or of a year or two be cured, or after on incomplete amelioration become chronic

and remain stationary, or eventually be aggravated into a progressive involution.

B. CHRONIC PSYCHOPATHIES (incurable, stationary or progressive).	Dementias.	(1) Traumatic or acute infections of exogenous origin, of direct and military etiology, wounds of the head, commotions, fevers contracted in the Service. (2) Chronic organic, of endogenous origin, of indirect and extra military etiology, general paralysis, arterio-sclerosis, cerebral syphilis, alcohol.
	Chronic Psychoses.	(1) Post-confusional Psychoses of depressive form, and demential deliriant. (2) Intermittent Psychoses. Maniacal or Melancholic attack; first attack, or preceded by similar attacks prior to the war. (3) Chronic Psychoses of a first insane type.

“Among the chronic states (1) the Dementias, (1) the Psychoses are the direct consequences of the war; the others, Dementias (2) and the Chronic Psychoses (2 and 3), are either totally unconnected with military service or indirectly provoked by the war, which play in their determination an etiological rôle either revelator, or aggravator, or accelerator.”—Dupré.

Exhaustion Psychosis

The psychoses which are especially attributed to war are the various types of confusional insanity, or, as it is frequently termed, exhaustion psychosis. Regarding this psychosis we have already seen that shock, whether emotional, commotional or, as more often happens, a combination of the two, is responsible for a state of mental confusion which, as in some cases of concussion, may persist for a considerable time. But a careful inquiry into the family history and upbringing of these cases will usually show a predisposing constitutional condition.

Hallucinatory mental confusion or, as the French term it, “oniric delirium,” is characterised by mental enfeeblement

and confusion; also there is disorientation in time and space, but there is besides an active delirium, coloured by the experiences of the war. It is not only ideational delirium, but it is a delirium of action. A prey to day-dreams, the subject loses contact with reality, and patients thus affected may show a complete disregard of danger by placing themselves in exposed and dangerous positions without exhibiting any fear. As these patients forget all about their actions these cases are of importance from a medico-legal point of view.

As regards exhaustion being a cause of this psychosis there is a considerable difference of opinion; undoubtedly exhaustion psychosis is a comforting term to use when we do not know what the mental condition exactly is, nor what the outlook is. The patient may have had a fever such as typhoid, malaria, influenza or pneumonia, etc., which in some instances has been preceded or followed by prolonged stress of war. A mental disorder, characterised by confusion, follows, and it is assumed that it is due to an exhaustion process affecting the brain, but the facts about to be related rather indicate that a constitutional predisposing cause is at the root of most cases diagnosed as exhaustion psychosis. "For amongst 10,000 Serbs who were taken prisoners of war after suffering the most severe exhaustion, hunger, and loss of sleep, and after being subjected to all manner of infectious illnesses, leading to cardiac weakness with oedema, gross wasting, great loss of strength and a high mortality from tuberculosis and other infectious diseases, only five cases of psychosis developed, a number not higher than would have been expected in peace times amongst a similar number of civilians." From this it may be deduced, says Bonhoeffer, that the acute exhausting influences of malnutrition, lack of sleep, and excessive exhaustion do not of themselves lead to the development of psychoses; and he agrees with Aschaffenburg that exhaustion and overwork must be

relegated to the background when considering the psychopathogenetic causes of mental diseases. Microbial toxins of infectious diseases are usually held to be one of the principal causes of exhaustion psychoses. When a man has been exposed to shell fire and he has acquired an infectious disease, the onset of an exhaustion psychosis is apt to be attributed to shell shock.

Then with regard to emotional causes Bonhoeffer points out that Bresler in 1914 showed that the so-called mobilisation psychoses were all either the reactions in patients who had formerly suffered with mental disease or else other forms of psychopathic reactions.

In the women who fled from Galicia and East Prussia and in the civil population of the invaded territories of Northern France, no great increase of mental disease has occurred.

Balz has shown that fright leads to an emotional paralysis and a dissociation of consciousness which in general lasts for a short time only, but which in certain pathogenic states may persist for a considerable time as hystero-neurotic manifestations.

Dementia Præcox

Dementia præcox must necessarily occur in a number of adolescents after joining the army. About 14 per cent. of mental cases in soldiers suffer with this disease. A careful inquiry into the history of these cases frequently shows that prior to military service there were indications in their conduct and behaviour pointing to a mental instability or derangement, or possibly there is a history of what is termed a nervous breakdown. On joining the army and before they have seen active service the disease often reveals itself by petty delinquencies such as late for parade, dirty gun, absence without leave. At first they are punished, then a medical inquiry is instituted and the

disease is suspected or diagnosed. There appears to be no special modification of symptoms on account of military service. The same three types of kalatonic, hebophrenic and paranoidal are met with.

Most of the cases of dementia præcox are revealed during military training. Severe commotional cases in which there is emotional indifference and stupor with complete anterograde and retrograde amnesia might be mistaken for dementia præcox in cases where a history cannot be obtained.

Psychasthenia

Psychasthenia is a term applied to anxiety-neurosis with morbid obsessions and phobias associated with signs and symptoms of nervous exhaustion. There is nearly always a history of an inborn psychopathic tendency in patients suffering with psychasthenia. Not infrequently there is a history of head injury or commotion.

The paroxysms of anxiety may be associated with tachycardia, hypotension of the pulse, and vaso-motor reactions, arising without any special cause. The power of reasoning and judgment may in all respects, except concerning the morbid obsession or phobia, be normal. However, by reason of the exhaustion and the inborn psychopathy there may be a failure of logical sequence of thought and conversation; this is not due so much to failure of comprehension as to inability to concentrate attention. This condition is so pronounced at certain moments in severe cases that the patient at times appears to suffer from a mental eclipse. Although there may be times when the patient presents an abeyance of symptoms, nevertheless the disease, having its roots in an inborn tendency, these periods of calm or comparative calm are liable at any time to give place to active periods, characterised by a return of the obsession with its accompanying distressing

anxiety. The symptoms are not relieved by drugs. In the less unfavourable cases a treatment combining both the principles of the rest cure and psychotherapy may bring about a sufficient adaptation to enable the patient to be of some military use. As a general rule cases of obsessional psychasthenia are of little military value, and should be discharged from the service. Of the various phobias met with, claustrophobia (fear of closed spaces), agorophobia (fear of crowded places), and syphilophobia are, according to my experience, by far the commonest. Associated with these morbid fears there may be a certain degree of mental confusion. In severe cases, which, however, are rare, the mental confusion may be associated with hallucinations.

Feeble-mindedness

Quite a number of soldiers have been conscripted who are feeble-minded; they are mental defectives, and upon inquiry they will be found to have only reached a very low standard in the school, subsequently they were out of work as often as employed, and they were of low wage-earning capacity. Frequently these men are not only mentally but physically inferior, and such should never have been recruited, for they will not repay military training. Not a few of these mental defectives are also congenital epileptic imbeciles.

About 18-20 per cent. of the admissions to military mental hospitals are mentally defective. A small proportion of these are high-grade imbeciles of the criminal type; the remainder are mentally and often physically so inferior that although they had no criminal propensities, yet experience has shown that for the most part they are quite useless for active service: "Sometimes they had proved dangerous to their comrades, and were permitted to load their rifles only when an attack was made."

Epilepsy

The question of epilepsy arising from stress of war and shell shock is of great importance, and in a discussion which took place in January 1916 at the Royal Society of Medicine upon "Shell Shock without Visible Injury," Dr. James Collier stated: "I do not think psychopathic and neuropathic antecedents are of importance as determinants of functional manifestations. What seems more important are the proximity of the explosion and the violence of the sensory effect, provided consciousness be retained." He then went on to say: "Major Mott has referred to epilepsy occurring *only* in those who had previously had fits or in whom there is a family history of the disease." What I did say was: "The history showed that cases which were said to have developed true epilepsy as a result of shell shock, were either *nearly always* individuals who had previously suffered with true epilepsy or an anomalous form of it, or that they were potential epileptics prior to the shock; this might be assumed from the fact that they had suffered with slight faints or automatisms, or that there was a history of epilepsy or insanity in the family." In support of this statement I carefully summarised the pre-war histories of all the cases of epilepsy under my care who had been returned from the front for six months. I was enabled, from the very careful notes taken for me by Dr. Cicely May Peake, who for six months devoted her whole time to investigating these functional cases for the Medical Research Committee, to show that my statement was based upon facts (*vide* p. 108). Subsequent investigations by myself and others have convinced me that true idiopathic epilepsy is constitutional and can seldom be attributed to commotion. Dr. Salmon states that: "Seven per cent. of cases received at Dykebar War Hospital were suffering from epilepsy. With one exception all had the disease before enlistment." This question is

of great importance in deciding whether a pension should be granted. Now epileptics are not admitted to the army, if it be known, and recruits are required to state that they have not suffered from epilepsy. Many do not know, but some wilfully conceal the fact that they had previously had fits, or they may think that they have been cured. Again, a man may know that if he can claim that he is an epileptic his services will be no longer required, and he can state that the shell shock was the cause, and claim a pension for being incapacitated by active service. A few epileptics make good soldiers, but in the majority of instances they are unfit for active service, not only because at a critical moment they might have a fit or psychic equivalent of a fit, but because many of them cannot submit to discipline.

Differential Diagnosis of Idiopathic Epilepsy and Traumatic Epilepsy

A number of cases are sent back from active service on account of "fits." The fits are not infrequently said to have come on in consequence of shell shock, gunshot wounds of head or contusions from various causes. A careful inquiry often reveals the fact that the man had suffered with fits before he joined the army. Fits which make their first appearance soon after, or in consequence of a head injury or commotion, are hysteric in origin. Undoubtedly Jacksonian epilepsy may arise as a result of penetrating wounds of the skull and depressed fractures near or over the motor area. Later encephalitis, cystic degeneration, or meningitis near the motor area may give rise to epileptiform seizures without paralysis. These Jacksonian fits proceed at first by a definite march and tend by continuance to extend to the whole of the body, so that the clonic spasms spreading rapidly with loss of consciousness may cause a fit which resembles idiopathic

epilepsy. The history of an injury to the skull, the evidence afforded by examination (aided by X-rays, if necessary) and a description of the onset and march of the fits when they first occurred, will suffice to differentiate idiopathic epilepsy occurring in a man who has suffered with a head injury. This is of importance when a pension or gratuity is considered.

In Babinski's service at the Hôpital de Buffon, amongst 150 cases of cranio-cerebral traumatism there were 19 cases of generalised epilepsy, whilst there were only 15 of Jacksonian. According to Netter the generalised traumatic epileptic seizures resembled attacks of idiopathic epilepsy, but showed the following peculiarities: greater frequency of an aura, the nature of which depended upon the seat of the lesion, and the predominance of the convulsions on the opposite side of the body to that of the trauma which may affect the frontal, temporal, parietal or occipital regions.

Injury of the frontal lobe may be followed by no epileptiform convulsive attacks, but I have seen several cases of automatic wandering without any other symptoms follow injury of the frontal lobe.

Differential Diagnosis of Epilepsy and Hystero-Epilepsy

Before epilepsy is diagnosed in a man who suffers with fits the army regulation requires that a fit should be witnessed by a medical officer. But he should do more than witness the fit, he should ascertain the premonitory symptoms and observe the after-effects upon the patient's conduct and general behaviour. Jellinek has pointed out that for 5-15 minutes after a fit the plantar reflex is extensor instead of flexor.

When a diagnosis of epilepsy has been made the question arises, What should be done with the patient? Before

man-power became a serious problem the patient was boarded out of the service, now we have to consider whether he cannot be utilised in one of the categories for home service. A few cases can be placed in B1 for garrison duty, a larger number can be utilised for labour and placed in B2 and a certain number in B3 for sedentary occupations. I prefer to board them out of the service if they can be utilised for work on the land as farm labourers, for that occupation is most suitable for them.

A number of cases returned as epilepsy are really hystero-epilepsy; the patient loses consciousness and exhibits motor reactions which might easily be mistaken for those of true epilepsy, except that they are excentric rather than concentric. The patient rapidly recovers, instead of falling into a deep sleep as occurs in epilepsy. Bromides have little influence in preventing these psychogenic seizures.

Lapses of memory of a psychogenic nature are liable to be confounded with attacks of masked epilepsy (fugues), in which the patient, instead of having a fit, behaves like an automaton.

The military value of hystero-epileptics is extremely low; they are only fit for home service, in one of the grades B1, B2, or B3. In fact, similar treatment is required as in the case of epileptics.

The epileptic is much more liable to become dangerous to himself and others than the hystero-epileptic. In illustration thereof, I will cite a case which came under my notice. An alien Jew, who had voluntarily enlisted early in the war, was discharged from the service on account of fits. He re-enlisted in another regiment. Later he was sent to the 4th London General Hospital to be examined and reported upon; as he had attempted to kill his C.O. and the policeman who arrested him. He had, he stated, no recollection of the incident. Later he had a typical epileptic convulsive seizure; I ascertained

that his father had been for ten years in Colney Hatch Asylum suffering with a similar affection.

Attacks of "petit mal" are frequently not recognised by the patient as of an epileptic nature, but considered to be simple faints; consequently a soldier suffering with "petit mal" may declare that he has never had fits. Under the stress of war or in consequence of an emotional or commotional shock he may have his first convulsive seizure; the psychopathic constitutional factor consequently may not then be evaluated, for he will assert that he had never had fits and that the conditions of war have been the cause of the onset. A careful inquiry should therefore always be made both as regards the previous history of the patient and his family history; and in a large number of cases it will then be found that there was a pre-war history of epilepsy or an inborn predisposition.

Masked Epilepsy

Larval epilepsy in the form of fugues and periodic attacks of mental instability causing the individual to commit acts for which he may subsequently have no recollection and for which he cannot be legally held responsible, are frequently the cause of court martials. In such cases a careful history should be taken and the friends interviewed, if possible, to corroborate the statements, or throw light upon the case. Several cases have come under my notice in which a soldier was charged with either desertion or absence without leave, and information obtained from the nearest relations has proved conclusively that the man was an epileptic. It must, however, be born in mind that soldiers will plead on the grounds of epilepsy that "they were not conscious of the quality of their acts" when charged with desertion.

Soldiers of the old army were apparently sometimes aware of automatic wandering being a form of masked

epilepsy, and to escape punishment pleaded they had no recollection of what happened during a period of absence without leave. This form of malingering to escape punishment is not always easy to detect, but motives for this conduct and careful inquiry into the family and personal history will generally enable a correct judgment to be formed.

Some authorities find hypnotism a useful aid in the differential diagnosis between hysteria and epilepsy. The hysterical patient at the word of command reproduces the complete attack in all its details, whereas the epileptic, though he may carry out all the commands, shows no reaction.

The following case of hysteria illustrates this point. A young soldier who had been sent from the front was observed to have a curious mode of progression. He would take a few steps and then make a double shuffle forward of his feet, without hardly raising them. I placed him on a couch and sent him to sleep; he fell off the couch towards the left, turned over on his face and then commenced a rapid movement of both arms and legs, like running away. This same fit could always be reproduced. It had its commencement when a shell burst near him in a trench.

Manic Depressive Insanity

Manic depressive insanity or periodic insanity is nearly always due to an inborn constitutional psychopathic tendency, and in the majority of cases attacks of depression with agitation and excitement have occurred prior to the war, if there has not been actually an attack of certifiable insanity. These cases nearly always give, on inquiry, some evidence by the family history of a psychopathic tendency. The delusions, illusions and hallucinations are nearly always coloured by war experiences. The attacks do not seem to be promoted by stress of war, in the majority of cases, any more than other forms of

psychosis. No one with a definite history of an attack of manic-depressive insanity should be considered fit for military service, as the tendency to recur is one of its chief features. About 20 per cent. of the admissions to the military hospitals for mental diseases belong to this group.

Paranoia—Acute and Chronic Delusional Insanity

Paranoia—systematised delusional insanity—is not infrequent, and is usually characterised by delusions of persecution and self-accusations, generally having some relation to war experiences, and often based upon hallucinations and illusions. In these cases of delusional insanity there is frequently a family history pointing to a psychopathic inheritance. Cases, however, are sent back from the front as mental, and said to be suffering with delusions of persecution which, when investigated by an expert, are found to be sane, and the most that can be said of them is that they have either exaggerated their troubles or have imagined they have been unfairly dealt with by superior officers or non-commissioned officers. In a few instances undoubtedly they have had real grievances and should not have been returned as “mental.”

Disposal of Mental Cases.

In nearly all these forms of psychosis, as also of epilepsy, the question of pension and gratuity is a difficult one to decide. The Government, having accepted for military service men who afterwards develop a psychosis, has recognised responsibility for their care and treatment. No man suffering with a psychosis, who has served abroad, can be sent to a county or borough asylum until a reasonable period has elapsed, or it is deemed that the case is chronic or incurable. Certain cases of epileptic insanity and general paralysis with well-defined mental symptoms can be at once sent to a county asylum. Special hospitals

for mental cases have been provided for men and officers, and quite a number of cases diagnosed as exhaustion psychosis or confusional insanity are discharged as cured, or as sufficiently recovered to be given over to the care of their friends.

General Paralysis and other Organic Brain Diseases

General paralysis is now recognised to be invariably due to syphilitic infection upon an average ten to fifteen years previously. As a general rule no signs of syphilis are recognisable on the body, and in a large number of cases the primary infection was not recognised and treatment was either absent, late in its application, or insufficient. Skin lesions are very rarely met with, so that, unless a Wassermann reaction of the blood be made, latent syphilis would not be suspected. But if all conscripts with a positive reaction of the blood were rejected, nearly 10 per cent. of able-bodied men would not be admitted to the army. I examined for Sir John Collie 500 specimens of blood taken from men in apparent health, who applied for employment in the service of the L.C.C., and nearly 10 per cent. gave a positive reaction. Having, therefore, conscripted men with latent syphilis of the central nervous system, two important questions arise. (1) Does the stress of war convert latent syphilis of the nervous system into an active disease by promoting the growth of the spirochætes? (2) What should make the medical officer suspect this latent syphilis of the nervous system when examining a recruit or soldier? Examination of the pupils in a considerable number of cases serves to reveal the disease before any symptoms or other signs have developed. In fact, the presence of the Argyl-Robertson pupil phenomenon shows that a man is a candidate for tabes or general paralysis, even when no other symptoms can be detected.

Next in importance to the Argyl-Robertson phenomenon is the irregular pupil, which is more often met with than the fixed pupil in general paralysis in the early stages. Again, as in the other cases, unequal pupils are very significant and should always lead to further investigation of the nervous system by examination of the cerebro-spinal fluid for lymphocytosis, globulin and Wassermann reactions. I have seen cases of tabes and general paralysis which have been recruited, in which in all probability the pupil phenomena had been overlooked. Quite a number of cases in the predemential, preparetic and preataxic stage of these two syphilitic diseases have come under my notice. Some have been sent back for shell shock, others as neurasthenia, and a few have been diagnosed as general paralysis, or a query diagnosis has been made, for clinico-pathological investigation to decide for or against general paresis.

Some of these cases have had an attack of mania, recovered, and the disease had been apparently arrested by treatment; and in these the pupil phenomena were the sole objective signs of the existence of the disease. Examination of the cerebro-spinal fluid showed that the organism was still in the nervous system.

It has been found that the average age of the soldier who suffers with general paralysis is less than that of the civilian so affected. It may be assumed that shock from commotion or emotion may produce a vascular disturbance in the brain, causing a temporary cortical anæmia, thus exciting the onset of general paralysis by converting a latent into an active disease.

Although syphilis, therefore, is the essential cause of both tabes and general paralysis, nevertheless, a man with latent syphilis who has been conscripted should be entitled, and his wife also, to some compensation in the form of pension or gratuity, if either of these diseases develop subsequent to his admission to the army.

Of organic brain diseases, syphilis is the most frequently met with, as it causes various paralyses, speech defects and other motor, sensory, and mental disorders, as well as disabilities of the most varied kind, according to the nature of the lesions and their localisation in the nervous system. Tumours, tubercular meningitis and cerebro-spinal meningitis may occasionally be admitted with a diagnosis of shell shock. But persistent and increasing signs of intracranial pressure in the first-named and the result of the examination of the cerebro-spinal fluid in the two latter will enable a diagnosis to be made. Cerebral abscess from old frontal sinus or ear disease that has been latent for years may become active or rupture into the ventricles, and if the soldier has been exposed to shell fire it may lead to a diagnosis of shell shock. A more frequent cause of cerebral abscess are penetrating gunshot wounds of the head. The abscess may not develop till many months have elapsed after the injury.

The Diagnosis of Malingering

In the diagnosis of malingering there are certain general guiding principles to be considered. The first and most obvious is the discovery of the mind's construction in the face, a matter of individual skill which is in a great measure intuitive and cannot be taught; it is, as Maudsley says, "An act the principles of which it has not yet been possible to formulate; but there can be no doubt of the extraordinary skill which some persons acquire, or the value of the information which those who have the requisite acuteness and experience may obtain thereby." For, as Bacon said, "The lineaments of the body do dispose the disposition and inclination of the mind in general; but the motions of the countenance and parts do not only so, but do further disclose the present humour and state of the mind or will."

Again, Bacon says, "It is hard to find so great and

masterly a dissembler or a countenance so well broke and commanded as to carry on an artful and counterfeit discourse without some way or other betraying it."

It is in and around the eyes that we may discern most clearly deceit and cunning. The glance is furtive and the malingerer betrays uneasiness and suspicion when closely watched.

The expert should remember that he is not the only person who is studying the facial expression. He should maintain an impassive mien, for his countenance is being closely watched by a cunning and designing man ready to take to account any change of expression which would afford information.

Behaviour when under Examination

Some impostors exhibit an air of extreme simplicity, others assume a blunt manner and bluff, which they maintain even when they know they are found out.

Others, again, are resentful to examination, and are surly or ill-tempered. "But the special pitfall of the malingerer is his tendency to overact his part." Consequently it is rare that the malingerer does not sooner or later give himself away by some inconsistency or contradiction. Again, fraud may be manifest by some circumstance or act.

The illiterate man, on the one hand, through lack of knowledge resorts to cunning. He exercises his ingenuity in either withholding or concealing information. He refuses to give direct answers to questions even when they have no bearing upon his case. The clever, crafty man, on the other hand, has a plausible tale to tell, and protests loudly his honesty and desire to afford as much information as he can. He usually overdoes it and thereby excites suspicion, which leads to his being closely watched and found out.

The simulation of insanity to avoid service or escape punishment for a crime is not an infrequent mode of

malingering. Before an opinion can be given it is usually necessary to take the man into the hospital for observation.

The trump card which the malingerer plays is pain, a subjective symptom the existence of which it is difficult to deny, but the pain complained of he is incapable of localising, or he is only able to give vague answers respecting its situation. On one point he is very sure, and that is its severity, which has no remissions and is uninfluenced by treatment. But this is not in accordance with genuine pain caused by disease or injury.¹ If there is any evident disease or injury, however simple or slight, he makes the most of it, and oversteps the limits of genuine disability from such a cause. Often he affects symptoms foreign to the disease he seeks to imitate.

Ignorant of the causes that are capable of producing the disease he simulates, the malingerer favours such conditions as inoculation and vaccination, and this may lead to his undoing.

Many injuries and diseases which are simulated should lead to definite organic changes and objective signs. Thus in alleged coxalgia there will in time be discoverable changes in the joint and muscular wasting. In sciatica there will likewise be muscular wasting and changes in the electrical reactions tested by the condenser.

As malingering is a crime and its detection may be followed by severe punishment, it is very necessary to approach the case of a suspected malingerer without any bias and in a friendly manner, thereby gaining confidence and allaying suspicion. The observer should quietly and unconcernedly note the gait and station of the man as he comes into the room. Watch the manner he stands to attention and salutes. He may be left to undress for examination, and unseen he may be watched how he takes off his trousers and unlaces his boots; for all these acts

¹ The seat of pain does not correspond to the anatomical distribution of a sensory nerve (*vide* Figs., Appendix), nor does it correspond to the referred pain of spinal segmental distribution (*vide* Table, p. 176).

will give valuable information as to mobility of the joints and pain caused by movement. If he complains of a stiff knee, give him a low chair to sit down upon and observe if he bends it. If he should complain of feeling ill, take his temperature, pulse and respiration, and ascertain if he eats well and sleeps well. Also note his general attitude to his comrades and their attitude towards him. A man who swings the lead is generally known, and although his comrades will not give him away, they usually despise him and are glad when he is detected.

Questions in cases of wounds and injuries cannot be too searching. Careful consideration of his answers will often enable a correct estimate to be made of the degree of disability which would be caused thereby and the probable duration of it.

The Exclusion of Organic or Functional Disease

It is necessary to exclude organic or functional disease. Attention should be directed in every case to the mobility of all the joints; the evidence of any muscular wasting; the reaction to Faradism;¹ the pupillary reactions; the ophthalmoscopic examination of the fundus oculi; the condition of the superficial and deep reflexes; the ability to stand with the eyes shut without swaying; the existence of tremors of the outstretched fingers and of the eyelids, of the tongue and of the lips; and where necessary an X-ray examination.

Mistakes are made more often by not looking than not knowing, and a thorough neurological examination should always be made. So that the malingerer should not be able in defence to say, "Why, he never even examined me."

Quite early in the war I was asked to report on a reservist who had been in bed some weeks professedly unable to stand or walk. He was suspected of malingering, and

¹ In testing the reaction Erb's motor points should be the part of the muscle to which the different electrode is applied (*vide* Figs., Appendix).

was sent to the hospital for an expert opinion and report. I made a systematic neurological examination, and could find no evidence of organic or functional disease. He complained of pain in the spine. I therefore told him to indicate exactly the painful spots on percussion. These I marked with a blue pencil. I then repeated the manoeuvre, and found he indicated quite different points as being painful. I observed that his ears, as I sat behind him, were getting redder and redder. I stopped suddenly and said, "My man, I have given half an hour to your case, and I cannot find it conforms to any known disease. Get up at once." Which he did, and was promptly returned to his depot.

The element of surprise is sometimes useful where a malingerer overacts his part. A case of pseudo-coxalgia was sent to me for an expert opinion. He had been many months in hospital; he walked lame and complained of pain on passive movements of the hip. There was something in his facial expression and general behaviour which suggested that he was a malingerer or gross exaggerator. He was resentful to examination, and his general behaviour was unsatisfactory. I asked him whether he felt the vibration of a large tuning-fork placed on the shin-bone of the disabled leg. His reply was, "No, sir." I said, "You are a liar. Now, do you feel it?" He replied, "Yes, sir," and asked to be returned to his unit.

A Hebrew consulted me for neurasthenia with a view to obtaining exemption. He said he suffered with congenital deafness. I whispered in the left ear (which he said was the worst), "Put out your tongue," which he promptly did.

The malingerer can often be found out by suggestion of a disability. Thus a recruit was sent to me for a report as to fitness. He complained of a number of vague subjective symptoms difficult of proof or disproof. I said, "What about the sight?" "I can't see properly with my right eye." I replied, "That is a definite disability,

but perhaps it can be remedied with a strong glass." He was given test type to read, and of course he was unable to read even the large type with that eye. I then put on a + .25, and he was able to read all the type, and equally as well with a - .25. A report was sent in accordance with this finding.

Alcohol and War Neuroses

An inquiry regarding the influence of alcohol in the production of war neuroses and the value of the rum ration, which I undertook with the aid of Dr. Edith Green at the Maudsley Neurological Clearing Hospital, is of considerable interest.

A system of cards of four colours was employed: (1) White for Total Abstainers; (2) Blue for Occasional Moderate Drinkers; (3) Pink for Daily Moderate Drinkers; (4) Green for Heavy Drinkers.

One hundred and forty-seven cards were collected from the Maudsley patients, and sixty-two cards collected from Ruskin Park patients; the latter were patients who neither suffered from shell shock nor war neuroses.

Subjoined is a summary of this investigation.

147 CASES FROM MAUDSLEY NEUROLOGICAL CLEARING HOSPITAL

90 PATIENTS claiming to be ABSTAINERS, and of these :—

45 did not take the ration;

39 did take the ration; 23 of whom found it beneficial;

15 ,, did not find it beneficial;

1 ,, it made no effect.

6 were not offered the ration.

19 PATIENTS claiming to be OCCASIONAL MODERATE DRINKERS, and of these :—

6 did not take the ration.

13 took the ration; 6 of whom found it beneficial;

5 ,, did not find it beneficial;

2 ,, state that it made no effect.

31 PATIENTS claiming to be DAILY MODERATE DRINKERS, and of these :—

2 did not take the ration;
 29 took the ration; 23 of whom found it beneficial;
 4 ,, did not find it beneficial;
 1 ,, states that it made no effect;
 1 ,, made no remark at all.

7 PATIENTS claiming to be HEAVY DRINKERS, and of these :—

6 took the ration without comment;
 1 did not take it, but gave no reason.

62 CASES FROM RUSKIN PARK

(These patients neither suffered from Shell Shock nor War Neuroses.)

18 PATIENTS claiming to be ABSTAINERS, and of these :—

8 never took the ration;
 10 took the ration and found it beneficial.

9 PATIENTS claiming to be OCCASIONAL MODERATE DRINKERS, and of these :—

3 did not take the ration;
 6 took the ration and found it beneficial.

34 PATIENTS claiming to be DAILY MODERATE DRINKERS, and of these :—

3 did not get the opportunity—never been out;
 31 took the ration and found it beneficial.

1 PATIENT claiming to be a HEAVY DRINKER, and this one took the ration and made no comment.

Allowing for possibilities of error, I should say that at least 60 per cent. of the 147 cases of war neurosis admitted to the Maudsley Hospital were total abstainers, which is a percentage double of that of the 62 cases admitted to Ruskin Park suffering with wounds or diseases other than functional nervous conditions.

The high percentage of total abstainers among cases of war neurosis and shell shock was associated with fear of the consequences of drink, or a dislike of the taste of drink, consequently refusal to take the rum ration. Fear of the consequences, in a great number of instances, was due to the results in the home of paternal drunkenness,

and in fewer instances of maternal drunkenness, or drunkenness in both parents.

It will be observed that a number of total abstainers admitted that the rum ration had been beneficial, and that they had taken it when they had to "stand to" in the trenches wet and cold in the early morning, prior to getting over the parapet for an attack.

Moreover, I questioned a number of officers of all ranks, even including advocates of temperance, and with very few exceptions they were convinced of the value of the rum ration, if it were given out by an officer who saw that no soldier obtained more than his ration. They emphasised its utility as a stimulant when the men were wet and cold and had to stand to at dawn; it put the feeling of warmth in them, and gave them the necessary stimulus and ardour to go over the parapet for an attack. The general recommendation was to give it in the tea, and the men preferred it so; only a few cared for it neat; it was too strong. Many officers and men were of the opinion that on returning to billets, cold and wet through, a rum ration produced a comforting feeling and promoted sleep.

Alcohol thus judiciously employed may by its psychic effects be of undoubted benefit in warfare. It is well here to refer to the conclusions of the Advisory Committee of the Central Control Board (Liquor Traffic), "Alcohol, its Action on the Human Organism," of which the author was a member. The main effects of alcohol that have any real significance are due to its action on the nervous system. So far as direct action is concerned, alcohol when administered in moderate doses, in dilute form and with sufficient intervals, has no effect of any serious and practical account. The action of alcohol is not really a stimulant to the nervous system, but a sedative to the highest centres of control, and acts by causing a decrease of critical self-consciousness and anxiety.

"When stimulation of nervous function is really needed,

and when the individual has to meet an emergency which calls for the exercise of his highest powers of perception and judgment, alcohol is not merely useless, it is certainly and unequivocally detrimental. On the other hand, there are emergencies when, though the individual may also imagine that he needs to be braced up nervously, he would be assisted far more by a relaxation than by an increase of tension; and here the sedative action of alcohol, so far as the immediate effect is concerned, may be advantageous. The value widely attributed to the rum ration, under the conditions of acute discomfort, cold and strain, inseparable from trench warfare, may be explained in this way."

History repeats itself, for so early as the reign of Edward III, Raymond Lulli, the inventor of the UNIVERSAL ART, had great faith in "the marvaylous use and com-moditie of burning waters, even in warres, a little before the joining of battle, to styr and encourage the souldiours' mindes."

Alcohol as a Food

"Men do not as a rule take alcoholic beverages because they regard them as a 'food,' nor do those who abstain from these drinks do so merely because they doubt their food-value. The use of alcohol is dictated by the fact that, to the majority, the taste of alcoholic beverages and the immediate effect of alcohol are agreeable, and that the pleasure desired therefore outweighs their estimate of remoter harm."

The moderate use of alcohol by the many, however, is inseparably associated with or leads to abuse by the few, with all its attendant evils.

Relatively few cases of soldiers and non-commissioned officers direct from overseas suffering with chronic alcoholism have been admitted to the Maudsley Neurological Clearing Hospital. The percentage of cases of acute and

chronic alcoholism among officers admitted under my care has been higher than the percentage from the ranks.

Alcoholics are often returned as suffering with neurasthenia; or their drinking propensities have been discovered while on leave from active service by crimes or misdemeanours; or while undergoing treatment in hospital they have absented themselves without leave, returned to hospital intoxicated, or been sent or brought to the hospital in a state of acute alcoholic intoxication, or even in a state of delirium tremens.

An inquiry into the family and past personal history of cases of acute and chronic alcoholism showed that in many cases there was an inborn mental instability which predisposed an individual to drink. It is always difficult to decide the relative importance of the predisposing cause and opportunity. In some cases the family history showed that alcoholism, suicide, neuroses and psychoses affected antecedents in varying numbers, while in others no such history was obtainable, and the habit seems to have been acquired in early life as a result of convivial imitation or to drown dull care. Not infrequently the history showed that a brilliant career has been destroyed by the habit having become a vice over which the individual has lost complete control. Enfeebled will and power of concentration, failing memory and loss of moral sense, become manifest by carelessness, broken promises, lack of auto-critical faculty, neglect of duty, and unreliability in speech and conduct. Attacks of despondency, followed often by bouts of drinking which were attended either by boastful loquacity and quarrelsome excitement in which the individual became dangerous to others (*vin gai*), or the reverse happened, and the patient became maudlin, sentimental, tearful, perhaps depressed and suicidal (*vin triste*), according to the temperament of the individual.

Norman states that the number of cases among the soldiers in which suicide has occurred is disproportionately

great in comparison with those observed in ordinary times. Cut throat has been by far the most common method in this condition, as in suicidal attempts in general. Major Hotchkiss notes that of the forty-five cases of cut throat admitted to Dykebar Military Hospital during a year, eighteen were the subjects of alcoholism. "Many of these attempts were made during an acutely confusional stage, and later there was no recollection (or apparently none) of what had taken place. In others it was associated with intense depression, which alcoholic excess produces in certain individuals."

A quantity insufficient to affect the normal being is enough to render the individual with an invalid brain anti-social, consequently cases of shell shock, mental deficiency, neurasthenia, epilepsy, and especially head injury are very susceptible to the toxic effects of alcohol. According to the experience of Major Hotchkiss at Dykebar Asylum, between cases of delirium tremens and the chronic delusional form of alcoholic insanity are those cases which show such varied symptoms as mental confusion, depression, subacute excitement, and in practically all cases hallucinations. "The history of many of these cases suggested that though alcoholism was a prominent feature in predisposing to a mental breakdown, of still greater importance was the stress and strain of the campaign, and had it not been for this the breakdown would never have occurred or would have been postponed." Probably the family history in many of these cases of alcoholic hallucinosis would show an inborn neuropathic tendency.

According to my experience, and also according to the experience of most authorities, symptoms of chronic alcoholism and of alcoholic insanity have been found among the older men, and especially those serving in Labour Battalions, or that have been employed permanently at the base, where they have more opportunities of indulging in alcohol to excess. In the majority of cases of chronic

alcoholism the symptoms were auditory hallucinations and delusions of persecution. As in civil life, delusions of conjugal infidelity were common.

One elderly officer, a chronic inebriate, came under my care, and he had delusions of conjugal infidelity and visual and auditory hallucinations of a man "he had done in" whom he imagined had been the cause of his wife's unfaithfulness. This patient also exhibited a considerable degree of mental confusion, amnesia and coarse tremor; in addition there was muscular weakness of the legs, absent knee jerks and tenderness on pressure of the calves. A fairly typical Korsakoff psychosis with polyneuritis.

There is no form of alcoholism or alcoholic insanity which may not be met with, and the hallucinations and delusions, as in other forms of insanity, may be coloured by the conditions of warfare. If we consider the temptation that there is to drink during periods of great stress and anxiety when opportunity occurs, it is remarkable that more cases of alcoholism do not occur in the fighting line. Much more drink is, however, consumed during the suspense and inactivity in billets and camps, also during leave. All the evidence points to the fact that intemperance has in the past played a not inconsiderable part in the production of military inefficiency, especially in officers. The necessity of controlling and limiting the sale of alcoholic beverages has been brought home to the Government by war emergencies, and the greatly diminished consumption has made not only for military but for national efficiency. It is to be hoped that control of the liquor traffic will remain permanently in force after the war, and thereby help to solve a great social and economic problem.

Carbon Monoxide Gas Poisoning

The examination of a brain from a fatal case of shell shock led me to the conclusion that the man might, while

lying unconscious, have been exposed to gases resulting from incomplete detonation of some explosive. For I found throughout the white matter punctate hæmorrhages quite similar to those which I had found in pre-war times in cases of fatal carbon-monoxide poisoning. I drew attention to this in the Lettsomian Lectures on "The Effects of High Explosives upon the Central Nervous System." Subsequent observations have shown that carbon-monoxide poisoning in modern warfare is a very serious and fatal accident, which happens much more frequently in a war like the present, where mines and countermines are continually employed on a gigantic scale, than formerly. It was well known that explosives under certain conditions owing to insufficient combustion (as in confined spaces) produce carbon monoxide. The French military authorities have long recognised the danger of "*l'enivrement de poudre*." The Crairae disaster in 1885 well illustrates this fact. A monster blast of gunpowder in a quarry attracted a number of persons from Glasgow to the site. Twenty minutes after the explosion a hundred onlookers collected in the quarry; forty were rendered immediately unconscious; others fell down in a state of giddiness. Of the forty seriously affected, six died: some of those who recovered developed convulsions on regaining consciousness; in others there was delirium, after which the patients became drowsy and slept. No secondary complications occurred, but in all there was great prostration and a long period elapsed before they regained their strength.

Pre-War Knowledge of the Pathology of CO Gas Poisoning

The most frequent cause of gas poisoning in civil life is that due to carbon monoxide (CO); it is a frequent form of suicide, and mine disasters are responsible for many deaths from this gas. It percolates through the soil and

causes fatal poisoning. Being an inodorous gas and depending for its toxicity on its affinity for the hæmoglobin of the blood, for which it has an affinity two hundred times as great as oxygen, it follows that a man working in an atmosphere contaminated even with a small quantity of this gas, suffers with deoxygenation of his blood. When a man has been exposed some hours to an atmosphere containing more than 0·02 per cent. of CO, symptoms of poisoning will appear. A man can bear without serious inconvenience, for half an hour or more, an atmosphere containing from 0·05 to 0·1 per cent., but 0·2 to 0·3 per cent. is dangerous.

An interesting example of the value of the canary and the insidious origin of the CO poisoning came under my notice some years ago. Several cases of CO poisoning occurring amongst the female chorus-singers of the Italian Opera were admitted under my care to Charing Cross Hospital—they all recovered. One was severe enough to be kept in the hospital, and I saw her the next morning. Her blood did not give the carbon-monoxide reaction. A dead canary was brought with the patient from a house in Covent Garden, and the following history was given. The inmates of the house noticed the canary fluttering about and then falling off its perch dead, at the bottom of the cage; whereupon, suspecting gas poisoning, they left the house. The source of the CO was an electric cable under the house, which had fused, and the slow combustion of the bitumen that surrounded it had produced the CO, and this had percolated through the soil into the house.

Petrol or gasoline engines in submarines, in which there was insufficiency of air, were known to be dangerous on account of the production of CO, and white mice were recommended by Dr. Haldane to be kept in these boats for the purpose of demonstrating the existence of this gas in the atmosphere. For, as in the case of the canary, these small animals are extremely sensitive to the poisonous

influence of this gas, doubtless due to the fact that in such small creatures the respirations and the rate of the heart-beat are extremely rapid; 0·25 per cent. affects a canary in one minute, and in three minutes it falls off its perch. They are therefore utilised in military operations connected with mining, or in detecting the existence of the gas in dug-outs, craters, trenches, and mine shafts.

CO may be detected in the air also by the decolourising effect which it has on a solution of palladium chloride. According to Marshall, so little as 0·04 per cent. can be detected with certainty by this method.

ILLUMINATING GAS

Cases of poisoning occur as the result of an escape of this gas, which contains carburetted water-gas.

The amount of CO in illuminating gas varies very considerably in different towns; it may amount to as much as 50 per cent., and is then, of course, highly dangerous. If it were not for the fact that other gases, having a distinctly unpleasant odour, are present in illuminating gas, the admixture of water-gas would be attended with much more frequent fatal consequences than it is at present. The danger of CO poisoning occurs in many occupations, *e. g.*, in the process of making carbonyl of nickel. Some years ago I had the opportunity of studying the pathology of CO poisoning, especially that relating to the changes in the central nervous system, and of correlating the clinical symptoms manifested during life with the histological changes in the organs of the body and the central nervous system. These changes permit one to explain (in a measure) some of the more important clinical signs and symptoms met with during life in non-fatal cases which recover completely or are left permanently affected with symptoms of nervous disease. As these investigations have a direct bearing upon CO poisoning occurring in war conditions, I will reproduce a summary of the results I gave in

an introduction to the description of the brains in some cases of gas poisoning sent to me from the front.¹

Pathology of CO Poisoning

In 1907 I published in Vol. III. *Archives of Neurology and Psychiatry*, a paper on "Carbon Monoxide and Nickel Carbonyl Poisoning." I came to the conclusion that the nickel carbonyl poisoning was really due to the inhalation

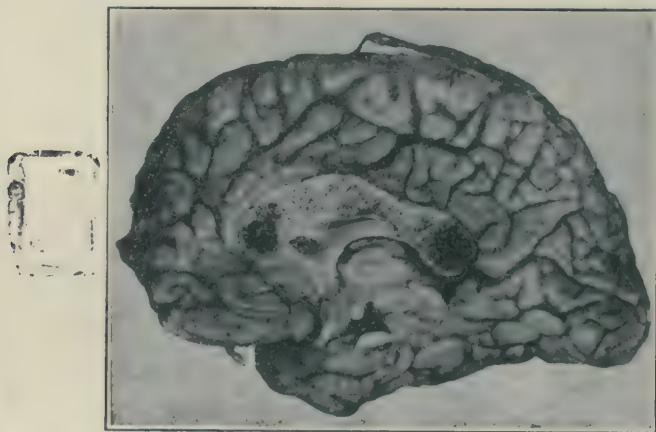


FIG. 56.—The right hemisphere of a worker at the nickel carbonyl manufactory, probably CO poisoning. Note the punctiform hæmorrhages in the corpus callosum, which have coalesced into hæmorrhagic masses at each extremity.

of CO employed in the manufacture of nickel. Two such cases occurred of which I had the opportunity of examining the central nervous system, and I found multiple punctate hæmorrhages throughout the white matter of the brain, as can be seen in the photomicrographs.

In this paper I compared the naked-eye and microscopic appearance of the central nervous system in these cases of nickel carbonyl poisoning with those observed in a case

¹ Read before the Pathological Section of the Royal Society of Medicine February 13, 1917.

of suicide by illuminating gas, and I considered them to be identical in nature. I also reviewed in this paper the clinical symptoms and pathology of CO poisoning in respect to the findings in the central nervous system and especially the causes which occasioned the hæmorrhages. All three cases died in from four to eight days with the complication of pneumonia. Thrombotic occlusion of cerebral arteri-

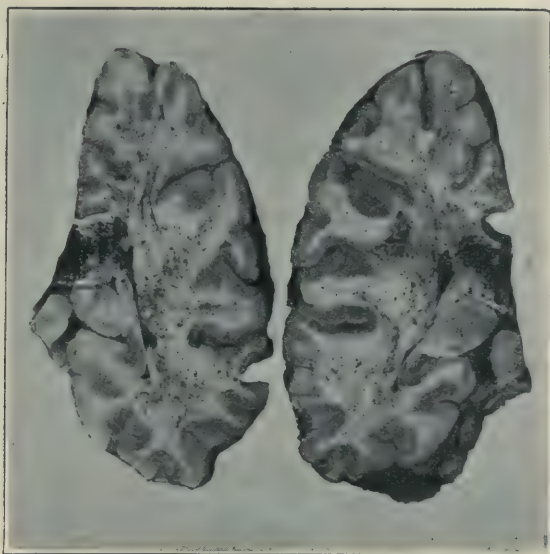


FIG. 57.—Vertical sections through the hemispheres, showing coalescence of the punctiform hæmorrhages in the corpus callosum and internal capsule, and throughout the whole of the white matter punctiform hæmorrhages.

oles or venules was considered to be the cause of the hæmorrhages.

In the case of suicide by illuminating gas, admitted under my care at Charing Cross Hospital, signs of cerebral hæmorrhage occurred within twenty hours of commencement of the inhalation of the gas, for the limbs became rigid, and a plantar extensor reflex was obtained. At first the temperature on admission was 99° F., but when the rigidity of the limbs and the plantar extensor response was

discovered six hours later, the temperature had risen to 105° F., and the pulse and respiration had become very rapid.

The nervous symptoms pointed to the occurrence of the punctiform hæmorrhages found post mortem in the internal capsules, and it may be assumed that the rise of temperature might have been due to the toxæmia coincident with the onset of pneumonia; for, when the patient died on the

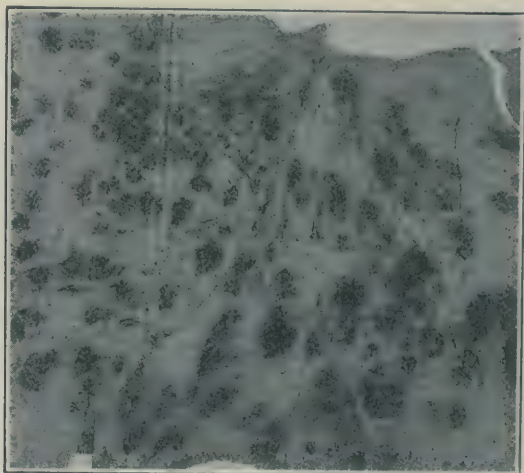


FIG. 58.—Photomicrograph of a section of the corpus callosum, showing the hæmorrhages. ($\times 10$.)

fourth day, pneumonic consolidation was found. But it might have been due to the cerebral hæmorrhages. Full notes of the clinical symptoms and post-mortem findings were reported. Microscopic investigation showed fatty degeneration of the heart, of the liver, and of the epithelium of the convoluted tubules of the kidney.

Punctiform hæmorrhages, attributed to hyaline thrombosis of small vessels of the white matter, have been described by Bignami and Nazari in various diseases, *e.g.*, æstivo-autumnal malaria, apoplexy, diplococcal meningitis following pneumonia and measles. It is possible, there-

fore, that pneumococcic toxæmia was productive of, or associated with, the causation of the hæmorrhages in these cases of CO poisoning.

But I am inclined to think that the CO poisoning alone would be capable of causing the punctiform hæmorrhages for the following reasons: in both cases from the Nickel Works there was evidence of old hæmorrhages in the form of minute round or oval punctiform patches of softening indicative of gas poisoning on some occasion previous to the man being obliged to give up work. And it was legitimate to attribute these symptoms they suffered from, viz. giddiness, vomiting and headache (migrainous attacks), to the gas poisoning, causing congestive stasis and hæmorrhages. It is well to note that these migrainous attacks are frequently met with in men and officers who have been exposed to those conditions in which CO poisoning might have occurred without fatal results.

From the facts observed in these three cases of CO poisoning, combined with certain anatomical conditions of the blood vessels supplying the white matter of the brain, to which I shall now direct attention, an explanation can be offered why these miliary hæmorrhages are found in the white matter of the cerebrum and basal ganglia, and

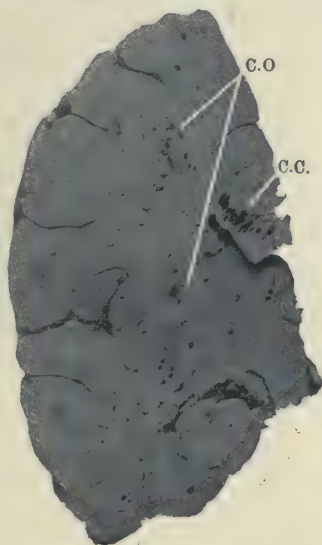


FIG. 59.—Vertical section of a cerebral hemisphere of a woman who committed suicide by inhalation of illuminating gas. Death in four days. Spectrum of blood showed CO poisoning. There are punctiform hæmorrhages throughout the white matter which have coalesced in some situations, notably the corpus callosum (C.C.) and centrum ovale (C.O.).

not markedly elsewhere in the brain (*vide* Figs. 56, 57, 58, 59). It must be recognised that a combination of factors may arise in CO poisoning, viz.—

1. The heart, owing to the anoxæmia, has to beat faster, and to do more work with less oxygen; consequently it may undergo fatty degeneration.

2. There is microscopic evidence of an irritative and degenerative endothelial change in the cerebral capillaries, as shown by mitosis of the nuclei, and a fatty degeneration, made apparent by osmic acid staining. These changes may be due, as Lancereaux suggested, to CO in the serum, but aggravated by the pneumococcal toxin, which is also responsible for a tendency to increased fibrin formation of the blood, and to thrombosis in those vessels in which the anatomical conditions favour the lodgment of emboli, or clotting of the blood from congestive or inflammatory stasis.

Miliary Hæmorrhages in Cases of Shell Concussion and Gas Poisoning

I may now mention that the microscopic appearances found in the brains of these cases of CO poisoning, dying with pneumonia respectively after four days, eight days, and seven days, were in all respects similar to the appearances presented by sections of certain brains received from France notified as dying of shell shock with burial (*vide* Fig. 15) and from gas poisoning; with one exception, and that only differed in the fact that a large part of the hæmoglobin had been converted into chocolate-coloured pigment granules which blocked the small vessels in the hæmorrhages (*vide* Plates I and II).

Before proceeding to the description of these cases, attention will be directed to the anatomical relations of the vessels of the white matter of the cerebrum where these hæmorrhages are found.

Anatomical Relations of the Vessels favouring Capillary Stasis and Hæmorrhage

The pia mater covering the cortex sends delicate-walled arteries and veins through the cortex to reach the subjacent white matter; the arteries consist of short and long vessels which, after giving off fine branches to the interlacing capillary network of the grey matter, terminate in a brush of fine arterioles; the short vessels end in this brush just below the cortex; the long penetrate deeper, to end in the corpus callosum and the centrum ovale. Each little artery breaks up into a tree, and forms a separate system of delicate arterioles. Each arteriole ends in a round or oval circumscribed area of capillaries, with an emerging vein. These veins do not anastomose. Thrombosis of arterioles or venules would therefore cause capillary stasis and hæmorrhage into the brain substance in a circumscribed area, also escape of blood into the perivascular sheaths of arterioles or venules; a condition generally found to occur where there are punctiform hæmorrhages. Owing to the thin character of the walls of the arteries, it is difficult to decide whether a vessel in section is an artery or a vein. Punctiform hæmorrhages are also found in great abundance in the brain structures supplied by the perforating arteries, especially those in which the opto-striate and lenticulo-striate branches terminate. These vessels give off relatively few branches until they reach their destination in the basal ganglia, and internal and external capsules; they then terminate in a brush of delicate-walled arterioles. Each vessel supplies, as in the case of the cortical vessels, circumscribed areas of capillaries, and the result of embolism, or thrombosis, is the causation of similar small limited areas of hæmorrhage and softening, which, when numerous, may become confluent (*vide* Figs. 56, 57).

Shell Shock and Burial. CO Poisoning

The brain of a man said to have died from shell shock was handed to me by Professor Keith for examination. The following notes accompanied this brain: Fatal case of shell shock with burial from Captain Armstrong, R.A.M.C., No. 7, Mobile Laboratory, B.E.F. Sent on from No. 1, Mobile Laboratory, No. 8 on Captain Armstrong's list.

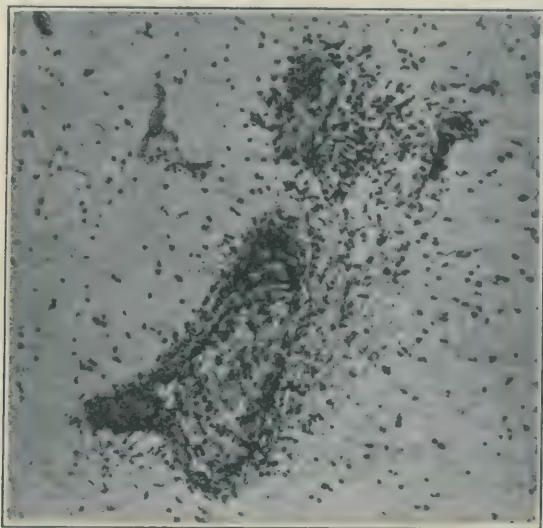


FIG. 60.—Photomicrograph of section of corpus callosum from a case of probable gas poisoning, showing inflammatory change around a small vein, a branch of which has ruptured. The deeply stained cells that are seen in the perivascular sheath are leucocytes. ($\times 200$.)

Brain of man, admitted unconscious, with history of having been buried by shell blowing in parapet. Remained stertorous for two days and died.

Post mortem.—There is no wound of any kind on his body or head, and no visceral lesion. His ankle on one side was badly “sprained,” but there were no fractures. The skull was unfractured, and no fracture of the base could be found. Brain shows multiple punctiform hæmor-

rhages, and some slight subpial extravasation (*vide* Fig. 15). No other particulars.

Having regard to the fact that these punctiform hæmorrhages and hyaline thromboses of vessels were identical in their microscopic appearances to those I had observed in CO poisoning, it occurred to me that the man may have been concussed, and afterwards gassed while lying unconscious and buried. In some sections of the brain there was evidence of inflammatory reaction around the small veins (*vide* Fig. 60).

It may be argued that these punctiform hæmorrhages were due solely to venous stasis and congestion, but I doubt this, for I have neither observed this condition in the number of cases of death from asphyxia, occurring in status epilepticus, nor after prolonged seizures of paralytic dementia, although I have examined the brains, macroscopically and microscopically, in a great number of instances.

A letter to me from the Trench War Committee confirmed the possibility of CO poisoning occurring when a large shell burst in a confined space, such as a dug-out or a trench, if incomplete detonation of the explosive occurred. Moreover, it must be remembered that CO is odourless, and may percolate through the soil from a mine explosion for long distances into trenches or dug-outs without its existence being known (*vide* p. 252).

In the Memorandum on "Gas Poisoning in Warfare," issued by the Director General, Medical Services, British Armies in France, in respect to CO poisoning, it is stated—

"The lungs show no abnormal changes in cases of rapid death. Small punctate hæmorrhages may be found in the white matter of the brain, and sometimes ecchymosis in the meninges, if the case has been exposed to a concentration of CO sufficient to cause prolonged unconsciousness."

The fact that CO is not found in the blood when the

patient is examined does not prove that death was not due to CO poisoning, for after some hours of exposure to air it cannot be detected, and there is little opportunity to make the test for some hours or even days.

Captain Dunn read an interesting paper at the Medical Society on Epidemic Nephritis, in which he showed hyaline thrombosis of the vessels of the alveoli of the lungs and of the glomerular capillaries of the kidney. In these cases he has observed multiple punctiform hæmorrhages of the brain, which he attributed to embolism by hyaline thrombi. These hæmorrhages present exactly the same appearances as in CO poisoning or gas poisoning. In a letter he has written to me, he states that he has now observed these hæmorrhages in four more cases of nephritis, so that their occurrence in the first case was not fortuitous. "They are of quite similar appearance to those I have observed in phosgene poisoning." He asks whether hæmorrhages of that type are seen in uræmia.

Lieut.-Col. Elliott has forwarded me a memorandum by Captain H. W. Kaye with five autopsies on cases of poisoning by drift gas (CL_2 and COCl_2), in which he describes blue-black dots in the brain of a seventy-hour case; he also refers to petechial hæmorrhages in the stomach and evidence of blood destruction in the spleen. Lieut.-Col. Elliott also calls attention to the fact that Captain Henry was the first to describe thrombi in the renal vessels, and he disagreed with Dunn and McKnee when they described emboli as coming from the lungs.

Examination of the Brain in Gas Poisoning

I have recently had the opportunity of examining the brains of two cases of gas poisoning, in which gas was employed in an offensive by the enemy; and one is of special interest, because the whole of the white matter is peppered over with small dark spots about the size of a

pin's head. These are due to hæmorrhages, but microscopic examination shows conditions which I have not found in CO poisoning, nor in other forms of gas poisoning; in fact, I have never seen any condition like this. The red blood corpuscles have been in large measure broken up, and the hæmoglobin converted into dark chocolate-coloured pigment granules, which fill the capillaries,

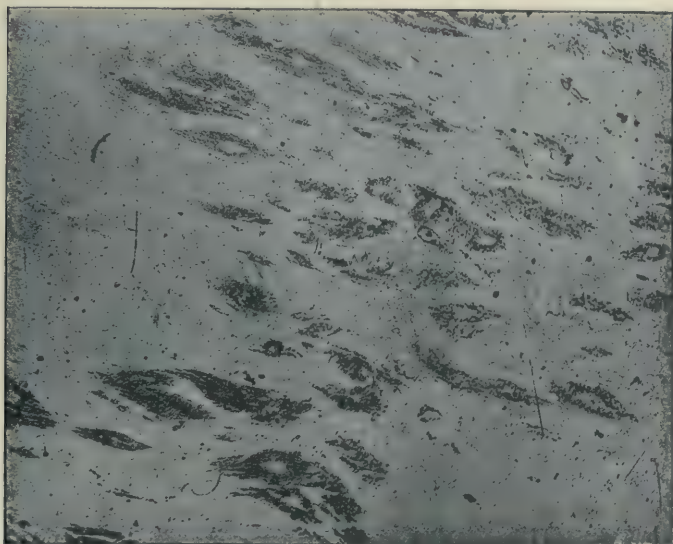


FIG. 61.—Punctate hæmorrhages in corpus callosum from a case of shell shock and burial; very probably accompanied by gas poisoning while lying unconscious and buried. Observe the small white area in the centre of the hæmorrhage, in the middle of which is a small vessel which, under a higher magnification, will be seen to contain a hyaline thrombus. ($\times 20$.)

arterioles and venules of the white matter of the brain. This is very possibly methæmoglobin, for it is known that exposure to nitrous fumes in concentration will oxidise the hæmoglobin, and convert it into methæmoglobin. Phosgene COCl_2 liberates HCl when it comes in contact with a moist surface; it is very irritating and would cause bronchiolitis. It is possible the free hydrochloric acid

would convert the hæmoglobin into acid hæmatin, and the altered blood pigment may thus be accounted for.

Similar appearances were found to those described in CO poisoning, viz. multiple punctiform hæmorrhages in the white matter (*vide* Fig. 61), but the blood corpuscles were intermixed with chocolate-coloured pigment granules pressed together by the hæmorrhage at the side; on one

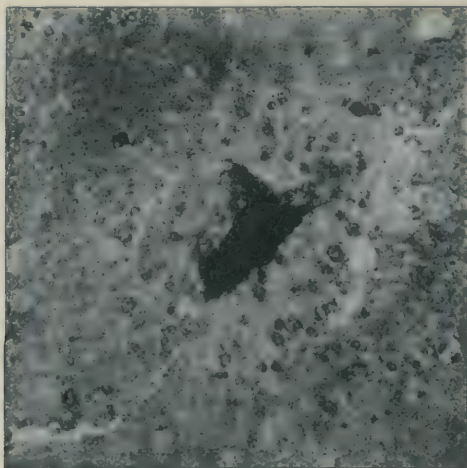


FIG. 62.—Hyaline thrombus of vessel in centre of punctate hæmorrhage. The thrombus was stained brown by dissolved pigment. Around the blocked vessel is a white area of brain substance containing numbers of leucocytes; outside this is the hæmorrhage, not very distinctly seen. The specimen was prepared from the subcortical white matter of the frontal lobe. ($\times 345$.)

there is an aneurism filled with pink-stained thrombus (*vide* Fig. 63). Amidst the corpuscles are numbers of pigment granules. The low-power photomicrograph shows three hæmorrhages with occluded vessels proceeding to them (*vide* Fig. 65). Nearly all the punctiform hæmorrhages show a central vessel, surrounded by an area of necrosed brain tissue, infiltrated usually with leucocytes. The whole of this area is stained pink by van Gieson

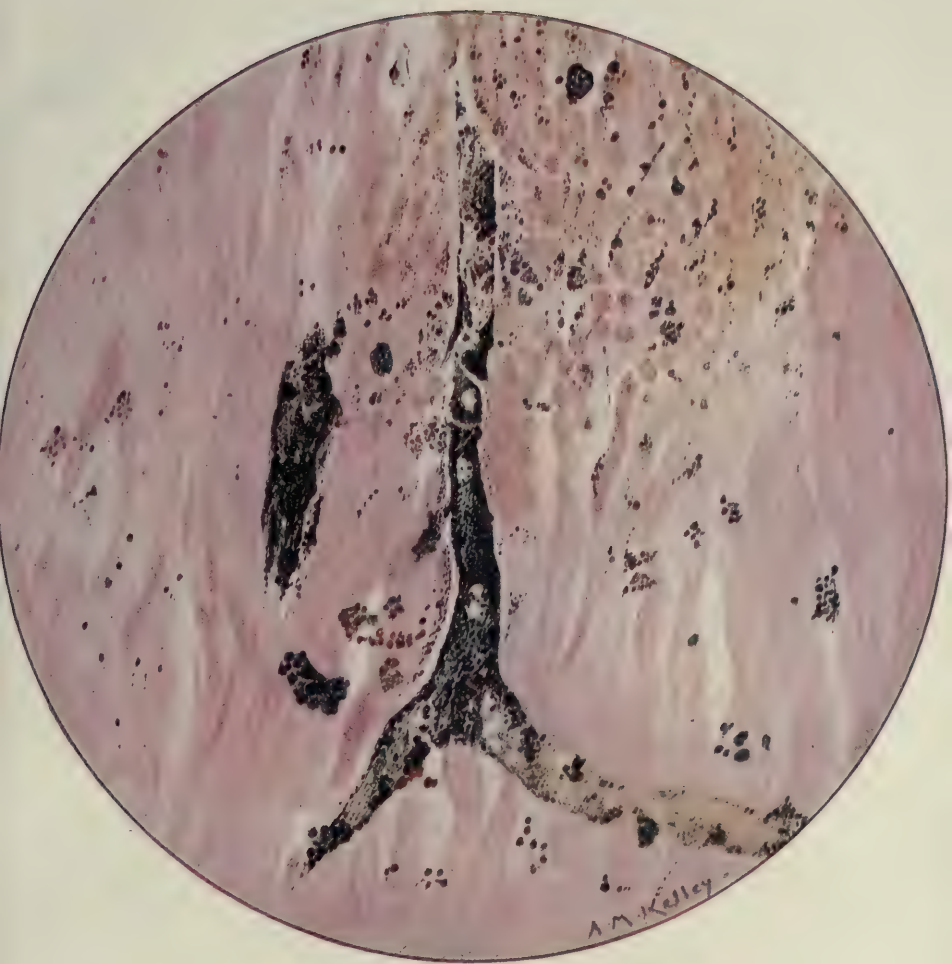


PLATE I.

Section of optic thalamus, showing vessel blocked with pigment going to hæmorrhage; amidst the blood corpuscles are numerous pigment granules. To the left of the larger vessel are three capillaries packed with pigment and compressed together. (x 350.)

stain, and it is more or less difficult to make out the wall of the central vessel. Sometimes a capillary filled with a thrombus can be seen running to the central vessel. It may be filled with chocolate-coloured pigment granules probably embedded in a coagulum, as in Plates I and II,



FIG. 63.—Leash of small perforating opto-striate arteries filled with pigment granules. Two of the arterioles show miliary aneurysms. ($\times 350$.)

or the coagulum may be of a pinkish-brown colour due to the coagulum being stained by the pigment dissolved in the serum (*vide* Fig. 62). In this, as in all other cases, there is evidence of an inflammatory stasis and excess of leucocytes in the vessels, and often into the perivascular sheath and tissues around.

Brief Clinico-Anatomical Notes of this Case

BRAIN.—Surface veins, large and small, distended with dark blue clotted blood (veins of base of skull were in same condition). Section shows thickly scattered blue-black dots throughout the brain, especially in the white matter;

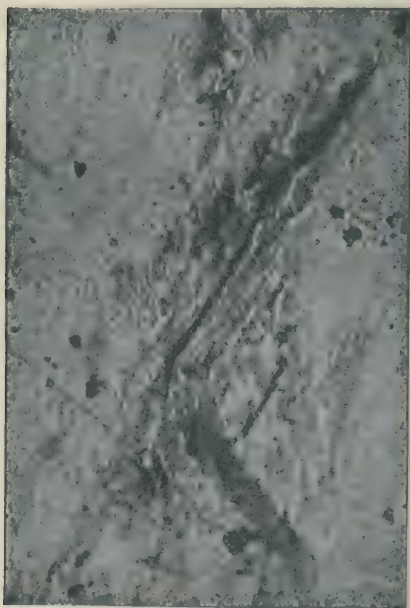


FIG. 64.—Small vessel breaking up into a leash of small arterioles compressed together by the hemorrhage. The vessels are all blocked with black pigment granules. Specimen from internal capsule gas poisoning. ($\times 70$.)

this applies also to the cerebellum, and to much less extent to pons and medulla. No hæmorrhage seen. Patient was admitted ten hours after being gassed, and died sixty hours after admission from bronchiolitis and failure of right heart.

It is unfortunate that the clinical and post-mortem notes of this case are so scanty, for it is one of great pathological interest. The right heart failure and bronchiolitis, from which the patient died seventy hours after inhalation of the gas, would undoubtedly account for the venous

congestion and stasis noted post mortem and for the thrombosis of the small vessels in the white matter of the brain. The blocking of the capillaries, small arteries and veins by the chocolate-coloured granules of pigment, especially of the capillaries, would however suffice to account for the hæmorrhages. In some respects the capillary blockage

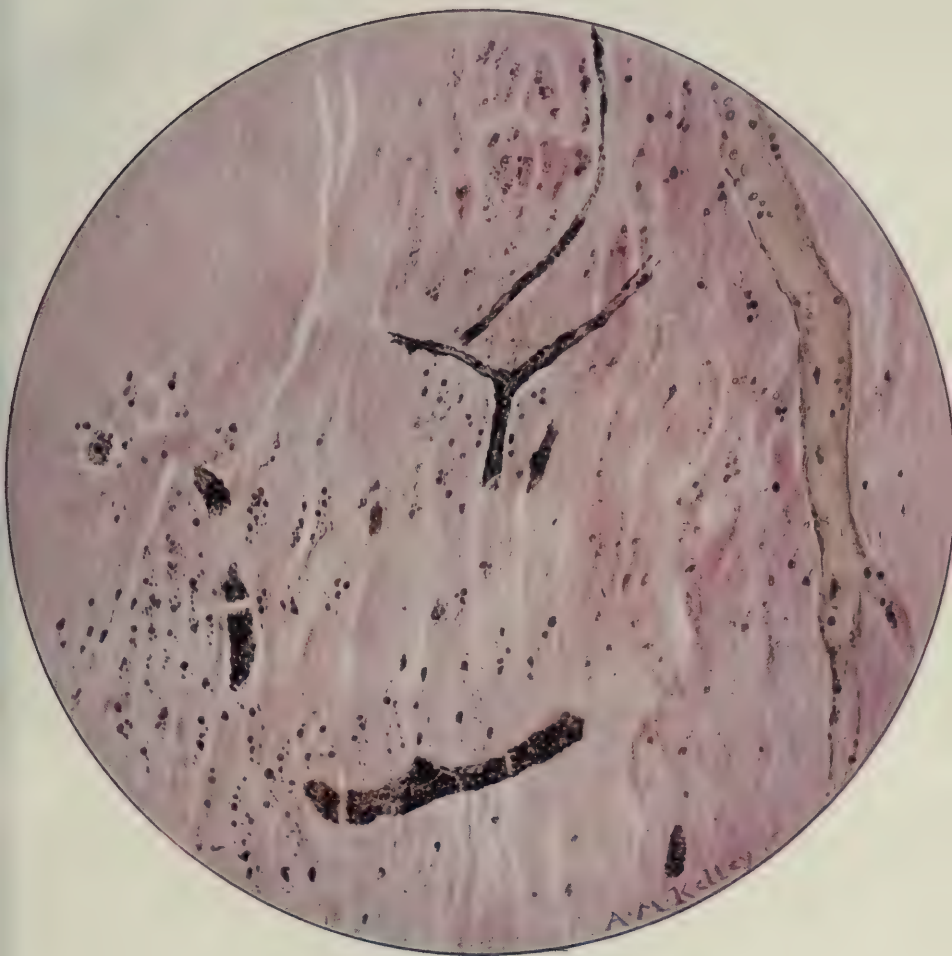


PLATE II

Small vessels blocked with pigment in hæmorrhage, and to the right a larger vessel, probably a vein, filled with lightly brown-stained hyaline thrombus. (x 150.)

by pigment resembles the condition found in pernicious malaria, in which disease Bignami and Nazari have described punctate hæmorrhage of the white matter of the brain; but I am inclined to believe the principal cause of the hæmorrhages is inflammatory stasis and hyaline thrombosis of arterioles, capillaries and venules, the pigment granules being incorporated in the coagulum.

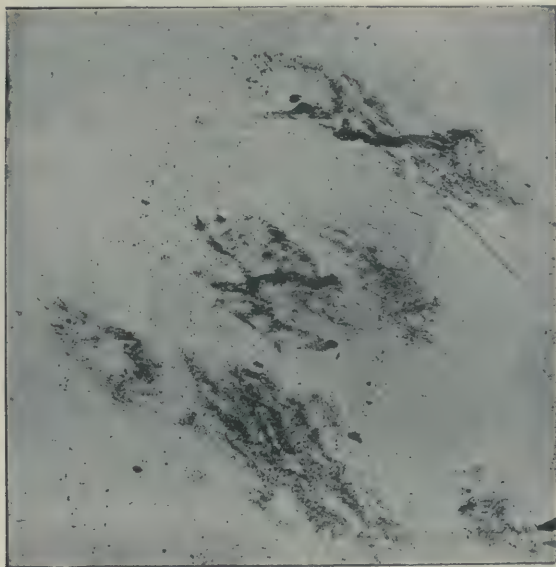


FIG. 65.—Three punctate hæmorrhages showing opto-striate arterioles filled with pigment granules. ($\times 30$.)

Microscopic Examination of the Brain in Shell Concussion with Gas Poisoning

I received the brain of another case in which the bruises on the body, the hæmatomata in the right lung, and the other conditions described, all suggest that he had been blown up by a shell and buried, and that the injuries of the brain were due to concussion. The fact that there was no CO detected in the blood does not conclusively prove that he was not exposed, while buried, to CO gas.

Clinical Notes of this Case

Admitted with diagnosis of shell shock. Purple bruises on arm and leg of right side. Stertorous, unconscious and during the night before death constant fits. Lived thirty hours in hospital.

Post-mortem.—There were two hæmatomata in the right lung, but no other visceral injury. No hæmorrhage of the scalp and no fractures of the skull. Some slight subpial hæmorrhage of the right hemisphere. Fornix destroyed and full of hæmorrhages; hæmorrhages also seen in corpus callosum. Hæmorrhage in both optic thalami: cerebro spinal fluid tinged with blood. Men admitted with him said he had been buried by a shell. There was no CO in his blood, and the bruising was purple.

Microscopic Examination.—Multiple punctate hæmorrhages are seen; hyaline thrombosis of capillaries, arteries and venules; perivascular sheaths contain blood. Marked evidence of inflammatory stasis. Some of the small veins are filled with blood corpuscles, one half of which are polymorphonuclear leucocytes, and in the perivascular sheath and tissues around are large numbers of polymorph leucocytes (*vide* Fig. 60).

Examination of a Brain from a Case of Gas-Shell Poisoning

Clinical Summary.—Unfortunately there are no notes of the condition of the reflexes nor the state of tonus of the muscle of the limbs. The clinical notes do not indicate that this patient suffered with pneumonia, nor any obstruction to the entrance of air to the lungs; there is no statement regarding the cause of the extremely rapid respiration but the fact that he was given oxygen and diffusible stimulants for the first twelve hours suggests air hunger. Later there is a definite statement; there is no evidence of cyanosis and no respiratory obstruction. The oxygen was stopped; but the respiration still continued very rapid, 50 to 60.

After some days his condition greatly improved, and the respiration fell even to 28. Then on the last day, in the morning, he suddenly developed grave symptoms, and in the evening it is noted that he developed marked nystagmus, internal strabismus, and the right pupil was distinctly sluggish and slightly larger than the left. The conclusions and findings are not inconsistent with CO poisoning, although to my mind

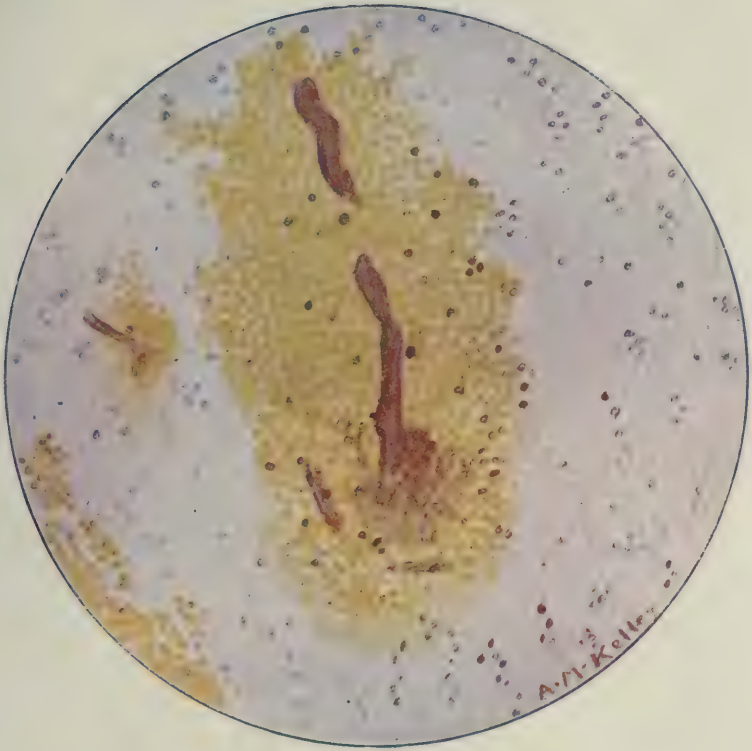


PLATE III.

Section of frontal cortex from case of shell gas poisoning.
Hyaline thrombus of vessel in the centre of hæmorrhage.
(x 150.)

it is more likely to be due to phosgene. I was unable to confirm the statement of hæmorrhage into the pons and medulla. The vessels were congested, but no hæmorrhage was found. The cerebral hemispheres were badly preserved, and I was only able to examine the cerebral cortex of the frontal lobes.

Microscopic Examination.—Portions of the frontal cortex and subjacent white matter showing to the naked eye miliary punctiform hæmorrhages were taken, and as in all the other cases blocked in paraffin, and sections cut and stained by van Gieson and hæmatoxylin eosin methods, also with polychrome. The punctiform hæmorrhages appeared in some of the sections to form a circle of circumscribed, discrete, oval or round areas of extravasated blood, with often a section of a vessel in the centre or proceeding to the hæmorrhage area. In sections stained by the van Gieson the lumen and the thin-walled vessels so seen appear a pale pink, and this is due to the contained hyaline thrombus (*vide* Plate III).

In some vessels, red blood corpuscles are seen with abundant fibrin formation: a similar appearance to that seen in the alveoli in red hepatization; other vessels appear filled with polymorphonuclears and fibrin. Around the central thrombosed vessels of the hæmorrhage are seen deeply stained pink areas of necrosed brain tissue, infiltrated with polymorphonuclear leucocytes; very often a vessel can be seen filled with blood and extravasated into the sheath, and occasionally the rupture of a thin-walled vessel causing hæmorrhage into the perivascular sheath can be seen. This condition of central thrombosis with necrosis of brain tissue around, and infiltration of leucocytes, is similar to that observed in the CO poisoning from the nickel works, when the patient lived eight days, and is in accordance with what might be expected, seeing that the man lived six days after inhalation of the gas.

Summary

The reason why these punctiform hæmorrhages occur in the white matter of the brain is primarily due to the anatomical condition of the vessels in the white matter of the cerebrum, where the arteries are terminal; each small artery having a separate capillary system, likewise the emerging veins. A tendency to stasis may be brought about in these separate vascular systems by the failure of the heart as a force pump and suction pump, also by

those respiratory conditions which lead to right heart dilatation and interference with the return of blood from the skull.¹ In the gas case, in which the hæmoglobin has been converted into pigment granules, it seems probable that the hæmorrhage may be accounted for by occlusion of the arteries. In most cases the two factors are combined. It seems probable, however, that either cause may act independently in causing inflammatory stasis and thrombosis, resulting in multiple punctiform hæmorrhages. It is unfortunate that with the exception of the case of CO poisoning by illuminating gas, I have not had the opportunity of examining the organs of the body.

It is quite probable that, as in that case, fatty degeneration of the heart, the kidneys, liver and vessels of the brain would be found to exist.

The symptoms of chlorine gas poisoning are as follows:—

Severe cough, spasm of the glottis, and if the concentration reaches one in ten thousand and continuance of the inhalation occurs, the struggle for breath becomes very acute.

The symptoms observed in men who were gassed with chlorine were due mainly to the irritating effects upon the respiratory passages causing coughing, choking, violent efforts to breathe and, in spite of their efforts, a progressive cyanosis and signs of asphyxia.

Added to the torture of the struggle for breath, is great soreness and pain in the chest. In some cases the asphyxial cyanosis gave place to a deathly pallor, and collapse due to cardiac failure occurred.

Phosgene gas, COCl_2 , was used by the Germans in their second gas offensive, as it does not cause the same acute bronchial irritation that chlorine does; it is able to penetrate the bronchioles and alveoli of the lung, and excite

¹ Dr. Sidney Coupland many years ago showed a brain with punctiform hæmorrhages, the result of asphyxial conditions consequent upon capillary bronchitis and heart failure.

an inflammation. Therefore, although its immediate effects are not so severe, it is more deadly in its ultimate effects.

Gas Burning in Mines and from Imperfect Detonation or Burning of Explosives in the Operations of War

Carbon monoxide is a gas which is especially dangerous when mines are exploded, or when there is imperfect detonation or burning of explosives, for the following reasons: it is inodorous; it can percolate through the soil without being absorbed or decomposed; it may be found in large quantities; it is cumulative in its effects on account of its affinity for the hæmoglobin of the blood; small percentages in the atmosphere in time will produce as marked poisonous effects as large percentages; indeed, cases of CO poisoning by long exposure to an atmosphere containing small percentages suffer with more severe nervous symptoms.

As I have ascertained, a man may be gassed by CO, causing nervous symptoms which are not recognised as being due to the gas, and, subsequently he is again exposed to the poisonous atmosphere and succumbs. The nervous system shows that the dizziness and migrainous symptoms with which he first suffered and which were disregarded, were associated with definite changes in the brain as revealed by lesions of a more advanced nature than the recent punctiform hæmorrhages associated with the second exposure.

It is generally believed that the poisonous effects of CO are entirely due to the combination of the gas with hæmoglobin, and in proportion to and entirely dependent upon a deoxygenation process; in fact, it produces anoxæmia. I do not think this fully accounts for all the symptoms, although it does for those in cases which recover upon reoxygenating the blood by the administration of oxygen and artificial respiration, even though brought out in a

state of unconsciousness. But why do they not recover with this treatment? What causes death? The answer may be that the cardio-respiratory centres of the medulla fail and the heart and diaphragm cease to act. One thing we do know is, that any exertion causing a more rapid and energetic action of the heart and diaphragm is liable to terminate fatally.

Fatal cases exhibit a fatty degeneration of the heart, and probably, as in pernicious anæmia, where there is a deficiency of oxygen, fatty degeneration of the diaphragm as well as of the heart occurs.

The recent work which has been done on oxydases, shows that thickly disseminated throughout the *grey matter* of the central nervous system (and not the white matter) are fine granules of oxidase; these are also seen in muscles and leucocytes, in fact in all living tissue where active chemical changes are taking place. We do not know what effect CO may have upon these oxidase granules. They may have an affinity for CO; possibly prolonged exposure to a small percentage in the atmosphere may be attended with more serious effects in the nervous system on account of a dissociation of the oxidase in the grey matter. At present this is speculation, but it may serve to account for some of the severe symptoms that attend some cases of CO poisoning which will be considered in detail later.

Causes of Explosives Producing Poisonous Gases

Although theoretically most of the carbon in explosives should undergo complete combustion, this by no means always happens.

Under certain conditions all explosives, whether high or low, are liable to give off noxious gases. Practically speaking, the only poisonous gas that demands attention is CO; for although nitrous fumes are liable to be formed,

as a rule they exist in such small quantities as to be negligible. When they exist in larger amounts they are readily recognised by their irritant action and odour; moreover, they are absorbed in a damp soil.

Some explosives produce more CO than others, thus gun-cotton produces a large amount even when there is complete detonation. All explosives in the presence of moisture are liable to produce CO. Certain high explosives, of the ammonium nitrate group, for example ammonal, are very hygroscopic in the presence of the least moisture, and produce then large quantities of CO. The explosives of this group employed by the Germans all produce abundance of CO. Deterioration of the charge by absorption of moisture may lead to incomplete detonation and production of abundance of CO. Thus damp workings, especially in permeable soils, are exceptionally dangerous for mining operations, particularly now that enormous charges are used. .

How CO Poisoning Cases are Caused

When a camouflet is formed by an explosion there is danger of a pocket of gas being formed; this may constitute a danger to galleries long after the explosion has occurred. When a crater is formed by an explosion of a mine the noxious gases escape.

A clay soil is less dangerous for mining operations than a permeable soil. CO poisoning has occurred from escape of gas in an old working; the gas may take the most peculiar directions, and after percolation through the soil it is odourless. Men are liable to suffer from CO poisoning on this account when a small mine is exploded near a gallery, for no notice is taken, as no physical effects are produced, but the gas is not able to escape and percolates through the soil; then by its cumulative effects upon the occupants of the adjoining gallery symptoms of gas poison-

ing are produced. A sapper under my care told me that the enemy exploded a mine, and he and another of a party of seven, who were working in a gallery near by, were the only men taken out alive. He had been a miner prior to the war, and said, "The gas came through into the sap." While in the field hospital, and after he had regained consciousness, he saw one of the bodies; it looked as if the man was alive, the cheeks and lips were pink. The symptoms he suffered with were vomiting, pain at the pit of the stomach, breathlessness, palpitation increased by any exertion, and for some time a splitting headache. When under my care the principal symptoms were of an emotive character, viz. tremor of the lower extremities and exaggerated deep reflexes with headache, dizziness, and insomnia, all of which were of psychogenic origin.

The trenches near a mine, especially if they are narrow and (owing to atmospheric conditions) badly ventilated, may, on explosion of an enemy mine, contain enough CO in the atmosphere to cause poisoning. A man who is concussed and buried by shell fire in a trench thus poisoned with CO may suffer not only with shell shock, but he may be gassed at the same time.

Again, soldiers who have taken refuge from shell fire in dug-outs, mine shafts, chambers, and mine craters after the explosion of a mine, have been gassed, and infantry are warned of the danger of these death traps.

Other causes of gas poisoning from incomplete combustion may be mentioned, viz. compression plants for ventilating mines, when, if impure mineral oil is used as a lubricant, CO may be formed in sufficient amount to constitute a danger. Gas may be formed also from the use of petrol engines in a confined space. Three men slept on the staircase of a large dug-out where there was a petrol engine used for illuminating the place; they all suffered with gas poisoning, and one of them subsequently came under my care.

The engineers are fully aware of all the dangers of poisoning by this gas, and instructions are given to them as to prevention and treatment of such cases when they occur.

Explosives like T.N.T. give rise to considerable quantities of hydrogen and methane, which are inflammable, and fires may result from their explosion; explosions of these gases in mines is one of the causes of the production of considerable quantities of CO.

Symptoms of CO Poisoning

As in cases of shell shock, so in CO poisoning, the psychogenic factor comes into play in cases of gassing; this has been strikingly apparent when a large number of men have been subjected to CO poisoning by a mine explosion. Still, there are certain symptoms which may be directly attributed to the anoxæmia.

When small percentages of CO in the atmosphere are inhaled for a considerable time the onset of symptoms is gradual and insidious. The first symptoms are related to cortical anoxæmia, viz. headache, vertigo, noises in the ears, deep sighing or yawning, with weariness and blurring of vision; followed later by mental depression, mild delirium with visual hallucinations, due to cortical dissociation, and eventually unconsciousness.

There is usually dyspnœa and palpitation, owing to the effects of lack of oxygen on the cardio-respiratory centres. Exertion will cause the oxygen available to be rapidly used up and hasten the onset of unconsciousness.

In some, there is a feeling of utter loss of power in the lower extremities, and when men have to be rescued from a mine they must be roped, or they will fall back into the mine shaft.

In other cases there are sensory disturbances, and the rungs of the ladder by which they are endeavouring to escape may feel two or three times their actual size. It is

remarkable that when they reach the surface and are exposed to the fresh air loss of consciousness frequently supervenes.

Sometimes the onset of symptoms is marked by languor, or a drowsy lethargy with an irresistible desire to rest. There is a feeling of cold and shivering, due to lowering of the body temperature, and it is easily understood why men who have been poisoned with CO rapidly succumb to

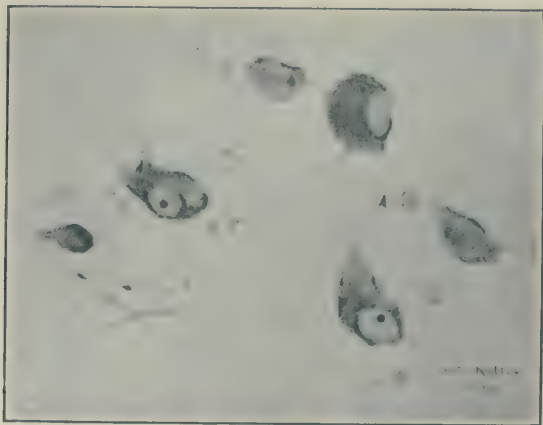


FIG. 66.—Sections of medulla oblongata from case of gas poisoning, stained by Nissl method, showing the swollen cells of the nucleus ambiguus. Observe the enlarged, clear, eccentric nucleus; the surrounding cytoplasm shows an absence of Nissl granules. In not a single cell is the nucleus seen in the centre, as it should be. ($\times 350$.)

pneumonia, especially if there is the additional cause of exposure to cold and wet in the trenches.

Cheyne-Stokes breathing, when it occurs, is a fatal omen, owing to the affection of the medullary centres (*vide* Fig. 66). The pulse, at first of normal rate or only slightly accelerated, becomes weak and rapid and the blood pressure falls. After death the face may appear life-like; the cheeks and lips being a cherry-red even when life is extinct; or there may be deathly pallor of the face and cold sweat.

After-effects of CO Poisoning

The nervous system and the heart are especially likely to suffer, and the post-mortem changes which I have described as occurring in fatal cases explain the persistence of the symptoms, which are, however, not due to persistence of CO in the blood, for it cannot be detected some hours after removal to the fresh air, and especially if oxygen has been administered. When men affected regain consciousness they appear dazed and stupid, and generally have no recollection of what has happened; there may be considerable mental confusion. Some look as if they were recovering from a drunken bout. The slightest excitement or cause for anxiety will bring on a return of the symptoms complained of, such as palpitation, precordial discomfort, tightness and oppression in the chest, pains and feelings of distress in the head, while beads of perspiration may appear on the forehead, and the facial expression assumes a look of anguish.

The effects on the nervous system may persist for some time, and are shown by a dazed, confused mental state; in some the speech is slow, hesitant, or slurred, and there may be a tendency to repetition of syllables or words; others, again, are listless, drowsy, and apathetic; while others may develop a maniacal excitement, fighting, laughing, shouting, and struggling. Nearly all cases suffer with intractable and persistent headaches. Frequently there are gastro-intestinal symptoms, viz. vomiting, hiccough, pain, and sinking feeling at the epigastrium. But of all the symptoms the most serious and persistent are the cardio-vascular; there is a breathlessness on exertion, precordial distress and discomfort, throbbing of the vessels in the neck, palpitation, and rapid pulse aggravated by slight exertion; there may be palpable evidence of cardiac dilatation. These symptoms are undoubtedly to be associated with fatty degenerative

changes of the heart muscle, and it is not to be wondered at, therefore, that many months may elapse before the patient recovers from these distressing symptoms.

Disturbances of the nervous system are most marked, and are manifested by amnesia anterograde and retrograde in severe cases; paramnesia; mental enfeeblement; loss of power of concentration, and ready fatigability. Symptoms, indeed, are so much like some cases of severe shell shock that one is inclined to think some of the cases of severe shell shock with burial are really complicated by CO poisoning. This seems all the more likely, in view of the fact that I have described cases of shell shock with burial in which there were punctiform hæmorrhages in the white matter exactly like those seen in CO poisoning, whereas in two cases of uncomplicated shell shock I found no punctiform hæmorrhages. As a rule, these symptoms pass off in time, but occasionally they may last years.

I was consulted by, and saw on several occasions subsequently, a naval officer of great promise, who in the early days of the submarines was gassed with other sailors. He developed an acute maniacal condition; then lost his speech for a time and became quite demented. Years passed, and he still showed a marked amnesia of all that he had learnt prior to the accident.

Cases have been described which presented features like those of disseminated sclerosis, and this is not surprising, seeing that widely-scattered punctiform hæmorrhages may occur through the white matter of the brain, which, when coalescent, would constitute considerable-sized areas of sclerotic degeneration.

Sensory disturbances of various kinds may result, and a neuritis may be the cause. It is remarkable that the deltoid muscle is picked out, and it has been noticed that the right is more likely to be affected than the left, probably because the right arm is used more than the left; the groups of extensors are more affected than the flexors.

As in shell shock, the personality of the individual plays an all-important part, nor can the psychogenic factor be underestimated.

Prevention of Gas Poisoning and Accidents in Mines

Underground warfare by means of mines and counter-mines charged with high explosives in quantities which, prior to this war, would have been regarded as incredible, has necessitated the enforcement of rules for prevention of gas poisoning of the troops, not only of the sappers actually engaged in mining, but of the infantry. Among the more important precautions which are laid down in the Army Orders are the following:—

1. When a blow occurs, even though this appears to be a long way off, all men working underground must at once come up.

2. No man should be permitted to descend the shaft of a mine without rescue apparatus till the mine is reported clear of gas. No man is permitted to ascend the shaft without being roped.

3. Infantry are forbidden to take part in rescue operations. Only men who know the dangers and have been trained to overcome and avoid them should be allowed to constitute rescue parties.

The gas helmet and box respirators issued to the army for the protection against chlorine and phosgene offensive gas are useless in prevention of CO poisoning. Special helmets and gas masks are employed. The presence of CO in the air can be readily detected by the effect of an atmosphere suspected of containing CO upon canaries or mice. These small creatures are affected in a few minutes; the former are more useful than the latter. A cage containing a canary with three sides of wire is carried into the mine gallery or dug-out, and from place to place, so as to sample the air in different situations. If there is CO in any poisonous percentage in the air, the

bird will ruffle its feathers in a minute or so, flutter, and in two or three minutes fall off its perch. The beat of the heart of the canary is 750–1000 per minute, and this rapidity of the heart action and circulation accounts for the rapid action of the poison; for the same percentage of CO in the atmosphere that produces effects upon the canary in two or three minutes will take at least half an hour to affect a man. Therefore, in any atmosphere which will cause serious symptoms of poisoning, the canary test will give ample warning long before the gas has any effect on the men.

Treatment

If the man has ceased breathing, artificial respiration should be immediately resorted to by Schäfer's method. Oxygen should be administered, the temperature should be maintained by warm bottles, hot bricks, and blankets. The stimulants that should be employed are hot strong coffee and hypodermic injections of strychnine. Alcohol should not be given. Every possible endeavour should be made to avoid exertion; for this may cause death from heart failure. No man who has been gassed and restored should be allowed to march back to the trenches.

The rationale of the preventive measures against gas poisoning, and the treatment which should be adopted when it has occurred, is obvious from a consideration of the facts stated in the previous pages.

The Effects of Irritant Gases upon the Brain

I have dealt at length with the subject of CO and Phosgene poisoning, as I have had the opportunity of examining the brains of fatal cases, but latterly a great number of men have been evacuated on account of exposure to irritant gases from shells charged with chemicals. Of these gases the so-called Mustard Gas (Di-ethyl-chlor-sulphide), on account of its pungent and irritating effects upon the skin and mucous membranes, is the most important.

This means of offensive has been most extensively used by the enemy; it is not within the scope of this work to do more than allude to the irritating effects on the mucous membranes of the respiratory tract, causing a pharyngitis, laryngitis, tracheitis and bronchitis for which the soldiers may be evacuated. Grafted on to these physical inflammatory conditions may be neurotic signs and symptoms. The man so affected, especially if he be a subject of constitutional neurosis, may develop neurasthenic and hysterical manifestations. The laryngitis may cause aphonia and mutism, and the idea that he can only speak in a whisper or that he is dumb becomes fixed in his mind.

Numbers of these cases have been sent to me, and have been cured with great ease and rapidity by physio-psychotherapy. The voice sometimes remains hoarse on account of a chronic laryngitis. The treatment of the inflamed pharynx and larynx by inhalation is very useful in the early stages when there is visible evidence of chronic inflammation, but its continuance on account of the neurosis is prejudicial to recovery, because it suggests a physical basis for a functional nervous condition. The inhalation which is recommended is Tinct. Benzoin $\overline{3i}$, to which Menthol gr. x is added. One teaspoonful of this is added to a pint of boiling water, and the vapour inhaled.

Another common hysterical symptom is blepharospasm, which persists after inflammation of the conjunctiva has subsided. Men suffering with this condition come wearing a shade over one or both eyes. The shade, like the crutches, acts as a constant suggestion and keeps up the disability. I have cured many cases by taking the shade away and isolating the patient in a darkened room, at the same time assuring the patient that the cause had gone and that the spasm would certainly cease.

The discomfort and pain produced by the irritation of the skin and mucous membrane causes insomnia and anxiety, which together with all the stress of active service tends to nervous exhaustion. So that a number of

officers and men after exposure to attacks by gas shells are sent home suffering with neurasthenia.

The enemy frequently mixes up gas shells with shells containing high explosives, and a great danger arises thereby, for the air in houses, streets, trenches and dug-outs may be saturated with irritant or poisonous gas; and the soldiers may be blown up by high-explosive shells, rendered unconscious, and partially buried beneath the débris, earth or sand, and therefore perforce exposed to drift gas (Phosgene) or the irritant Mustard Gas for some time before he can be rescued. This is enough to excite fear in the stoutest heart, and the terrible experience that a man may go through under such circumstances sinks deep into his mind, and produces a condition of hysteria or neurasthenia which necessitates his being invalided home suffering with one or a combination of both of these war neuroses. The cause is emotional rather than commotional, and the personality is the important determining factor of the severity and duration of the nervous symptoms.

Neurasthenia and Active Service

By the new Army Council Instruction No. 712 of 1918, no officer invalided home from overseas and admitted to a neurological hospital, suffering with shell shock, neurasthenia or functional disorder, can again be sent overseas for duty for at least six months after his discharge from the special hospital. "In no case will an officer be placed in Category A, B, D."

If the term neurasthenia were always limited to the definition of Dejerine, this new instruction would be very valuable; unfortunately the term is applied loosely, and war-weary officers feel it a hardship to be placed in a hospital for neurasthenics and hysterics, and subsequently sent to Home Service when they feel that a month's special leave would make them fit for active service. And I have found it sometimes necessary to change the diagnosis to Debility.

By an Army Council Instruction No. 517 of 1918, "Officers' University and Technical Classes," "Arrangements are now made for officers: (1) In Reserve Units, (2) in Command Depots, (3) in Hospitals, to be attached to certain Centres of University, Technical, Business, or workshop training, provided they are reported by a medical board as unlikely to be fit for general service, Category A, in less than six months, but fit to attend an Officers' University and Technical Class, which for this purpose is considered equivalent to Category C 2." Officers who desire to take advantage of these arrangements can obtain direct from the Controllers Appointments Department, Ministry of Labour, Gresham House, Old Broad Street, E.C.2, a pamphlet showing the regulations under which they may be attached to a centre of instruction, and an application form. This is an excellent provision for aiding the recovery of neurasthenia, as it affords interesting occupation and mental diversion. It tends to allay mental introspection and the feeling of depression caused by unfitness for service. An additional wise provision against financial anxiety is that an officer permitted to attend these classes receives full military pay and allowances. If he is found fit for general service he will be liable to be recalled to military duty.

"SOLDIERS

"(9) All soldiers suffering from neurasthenia, shell shock or other functional nervous disorders, when no longer in need of hospital treatment will be examined by a Neurological Medical Board at the Special Neurological Hospital, which will decide whether or not the soldier is fit for some form of military service.

"(10) If considered fit for further military service, the soldier will be discharged from hospital to furlough under III Employments and the A.F.W. 3016, and the soldier's medical history sheet (A.F.B. 178) will be clearly endorsed in red ink."

"Neurasthenia—not to be sent *overseas* until reboarded

by Neurological Medical Board under A.C.I. 712 of 1916."

If kept in the army he is sent to various employments for which he may be deemed suitable. He can only be employed on home service, but after the expiration of six months and after re-examination by the Neurological Board at one of the special neurological hospitals, it will be decided :—

(a) Whether the soldier is fit to be sent overseas, and, if so, in what category;

(b) Whether he should remain in his present category for home service only, and, if so, for what period;

(c) Whether he should be discharged from the service.

The authorities now recognise that the great majority of cases of "War Neuroses" proceeding from overseas are either unfit for any military service or not fit for service overseas for at least six months.

Experience has shown that in a conscript army a large number of men are necessarily recruited who are constitutionally unfit, and who will never repay the outlay made on them. It is useless trying to make these men soldiers, and it would be in the interest of the State to discharge them from the army as soon as they have been proved to be worthless material. When it is considered that a man even at the end of six months is not likely to have recovered sufficiently to be sent overseas, and his occupation prior to joining the army is one of national importance, such as farm-labourer, miner, skilled artisan, etc., it is better, in my judgment, to board him out of the service rather than send him to employment at his depot. There is another reason, and that is the tonic influence of leaving off the uniform and returning to civil life.

Chronic Functional Paralyses and Contractures in Pensioners

Chronic functional paralyses and contractures are due in great measure to lack of experience of medical officers

in the differential diagnosis of functional and organic disease, resulting in neglect of early treatment. Consequently, large numbers of soldiers have been boarded out of the army and have received pensions for curable disabilities.¹ The receipt of a pension does not tend to recovery in a number of these cases. No case should be discharged from the army with a curable disability. The Pensions Board at Putney, to whom cases are referred before discharge, has come to a similar conclusion, and has recently sent to me many soldiers to report upon (a) the disability, (b) treatment. Many of these cases have been admitted to hospital, and most of them have either been cured or greatly benefited.

The cases fall into three groups.

1. The neglected functional case.

(a) The type of contracture with deformity, *e. g.* talipes equino-varus (*vide* Fig. 42).

(b) The flaccid type with disuse muscular atrophy, *e. g.* brachial monoplegia.

2. Functional paralysis, flaccid type and contracture type following G.S.W., with or without fracture of bones and cicatrices, but the nerves of the limb not injured (Figs. 67-69).

¹ Colonel Salmon, Senior Consultant in Neuro-Psychiatry for the American Army, was sent to England in 1917 to investigate and report upon the "Care and Treatment of Mental Diseases in War Neuroses ('Shell Shock') in the British Army," and in this Report, published in *Mental Hygiene* (Vol. I, No. 4), he makes the following statement: "No medico-military problems of the war are more striking than those growing out of the extraordinary incidence of mental and functional nervous diseases ('Shell Shock')." Together these disorders are responsible for not less than one-seventh of all discharges for disability from the British Army, or one-third if discharges for wounds are excluded. A medical service newly confronted like ours with the task of caring for the sick and wounded of a large army cannot ignore such important causes of invalidism." He also adds: "Improper management may add to the primary neurological disability—which is largely beyond our power of preventing—secondary effects, which go even further in producing nervous invalidism. Long-continued treatment in general hospitals, confusion of the neurosis present with the organic nervous diseases, and unintelligent management, all tend to produce the chronic 'shell shock' cases which are so familiar in the special hospitals for these disorders."²



A.



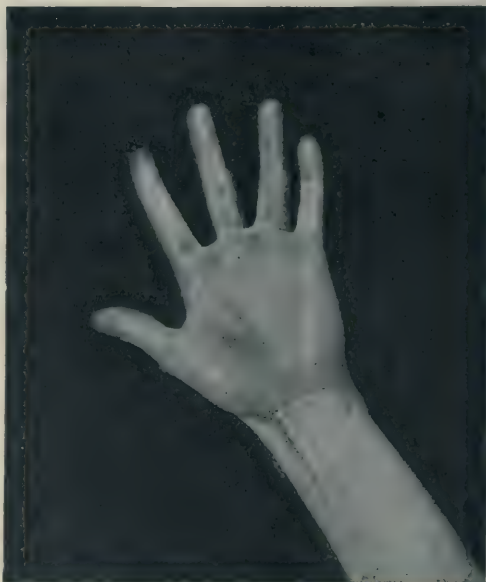
B.

FIGS. 67, 68, 69.—Pte. C.,
5th Wilts: Penetrating bul-
let wound of arm, April 1916.
Bullet removed a month after.
Functional condition' super-
vened; hand clenched and
unable to use it, no loss of
sensation. Sent to various
hospitals and convalescent
camps till cured by suggestion
in three weeks at the Mauds-
ley Hospital, July 1918. Now
working in the carpenter's
shop.

A. Usual position of clen-
ched fingers.

B. Attempt to move fingers.

C. After cure by suggestion.



C.

Many of these cases gave a history of prolonged immobility by the use of a splint, with consequent arthritic and muscular changes; in advanced cases there are vaso-motor, thermal and secretory changes in addition (*vide* Figs. 35, 36, 38). The pain of the wound or cicatrix may cause persistent reflex immobilisation, with secondary muscular and arthritic changes, suggesting to the inexperienced a permanent disability.

There are forms of chronic functional contracture and paralysis which are extremely difficult to cure. They are long-standing cases following wounds. The scars of the wounds seem to act as a constant source of suggestion of the permanence of the disability. In cases where the disability causes no serious discomfort, and ensures much sympathy, a light job, and the continuance of a pension, the idea of a permanent disability becomes installed and firmly fixed in the mind, so that curative contra-suggestion often finds the individual irresponsible and difficult to treat.

3. Organic paralysis due to



FIG. 70.—Injury of median nerve. Scar of incision for operation of suturing. Regeneration taking place as shown by the fact that pressure along the course of the nerve below the widest part of the scar gives tingling in the index and middle fingers. The position of the hand resembles a functional "Main Accoucheur," except that the little finger is inflexed on to the hypothenar eminence; but the cause of this condition is not functional, it is due to a cicatrix at the root of the thumb, and another along the palmar surface of the little finger. These cicatrices were caused by two incisions necessitated by septic inflammation and suppuration of the palm, a tube having been placed through from one incision to the other.

G.S. Wounds injuring peripheral nerves (Figs. 70, 71), the plexuses, or the spinal roots, with consequent motor paralysis, muscular atrophy and absence of electrical reactions or reaction of degeneration have been the cause of the disability and deformity. Usually there is associated with the paralysis of groups of muscles a corresponding area of anæsthesia (*vide* Table, p. 176). A large superadded functional paralysis sometimes occurs in cases of limited organic

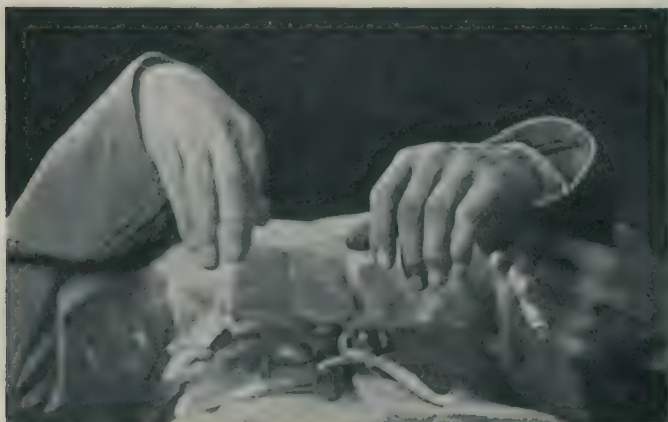


FIG. 71.—A case of accoucheur hand under chloroform anæsthesia. This case resisted treatment by physio-psychotherapy, and had to be discharged. A comparison of the right and left hand shows that the deformity still persisted, although he was under deep narcosis. The case was one of injury of the median nerve (Fig. 46), and tends to show that myogenic changes had taken place.

disability. In some of the cases the injured nerve had been sutured and regeneration had taken place, but muscular and arthritic changes had been allowed to occur from neglect of after-treatment.

My experience leads me to the conclusion that great numbers of soldiers have remained in hospitals, command depots and convalescent camps many months, and not an inconsiderable number for over a year, suffering with disabilities which could have been cured by a skilful neurologist in a few minutes, a few hours, a few days, or

a few weeks, and thereby an enormous saving of money and man-power might have been effected.

The General Treatment of War Psycho-neuroses

The essential before commencing treatment is a careful examination of the patient, and much time will be eventually saved by thoroughly going into the previous history of the patient in order to ascertain how much of his disability is due to pre-war acquired conditions, and how much to his inborn constitutional make-up as afforded by his family history—what he was born with, as well as what happened after birth; otherwise pre-war conditions may be confounded with conditions due to service, and the distinction of “in and by military service” not accurately gauged. Moreover, the information thus obtained is most valuable as regards prognosis in respect to whether he is unfit for military service, and should be discharged as permanently unfit. This information will also help in deciding which category the patient should be put in when discharged from the hospital. Again, it is of importance in deciding the amount of gratuity or pension which should be awarded in each case.

After taking the family and personal history, a careful examination of the patient should be made; not merely a physical examination, but a mental examination. This should be undertaken apart from his comrades, and every effort should be made to obtain the patient's confidence. He should be asked to tell you fully his troubles, if he has any, and particularly so if an anxious and worried expression suggests a mental conflict. Often the examining physician will find that the man is haunted by the terrible experiences he has gone through and by the sights he has seen, which trouble him by day and terrify him in dreams by night. The assurance that he will not be sent back will often do much to relieve his anxiety. Sometimes it will be found that he is worrying about family, domestic and financial troubles or in fear that he will never recover. When he

feels that he has found a friend in the doctor, who is not in a hurry, but will listen to him, he will have faith in him; and in these functional war neuroses due to psychic trauma Charcot's dictum is especially applicable, "*C'est la foi qui sauve ou qui guérit.*" It may take several sittings before the mental struggle which is at the foundation of his anxiety-neurosis is revealed to the physician. A sympathetic hearing of his troubles should be followed by wise counsel, and the endeavour to strengthen his will-power by encouragement and hope for the future. This is the psycho-analysis which every humane physician who tries to get his patient to regard him as his friend and confessor will practise, if he is not too busy.

A careful physical examination is next made. The patient has now confidence that his case is being thoroughly gone into; and having faith in the judgment of the physician he is open to suggestion. For he will reason thus: This doctor has not neglected me; he has not said, "Case of no interest," "Functional," "Shell Shock," "Neurasthenia," "Hysteria," which sometimes happens when such patients are mixed up in hospital with cases of wounds or of organic disease. The feeling, often imaginary, of being neglected and of being despised by comrades is not likely to induce faith, and thereby recovery.

In the main there are three types of cases which require treatment: (1) hysteria; (2) neurasthenia; (3) a combination of hysteria and neurasthenia.

The hysterical symptoms can be cured by physio-psychotherapy in several ways, and a detailed description of the methods will be given later. The neurasthenic symptoms can be greatly aided by suggestion, especially the anxiety states and phobias.

Treatment of Shell Shock and Neurasthenia

I am informed by medical officers at the clearing stations that there is an increase of pressure of cerebro-spinal

fluid in true shell-shock cases, and that sometimes even it is blood-stained or contains albumin; also that relief of symptoms occurs by withdrawing fluid by lumbar puncture.

The *treatment* of the neurasthenic symptoms of shell-shock varies to some extent in different individuals, according to their nature, but there are some symptoms which are seldom absent in all true cases, viz. tremor, fatigue, dizziness, headache, insomnia and terrifying dreams. I have found the continuous warm bath of great value in the treatment of these cases when they come over from France. The water in the baths is kept continuously at the temperature of the blood by a special mechanism of heat regulation; the patients are kept in the bath for a quarter to three-quarters of an hour, or even longer. The effect is most soothing to the nervous system, and one can understand how it is so from the fact that the whole of the sensory nerves of the skin are acted upon by the warmth; the tired muscles are relaxed, and the blood is withdrawn from the internal organs, including the brain, to the skin. These baths are extremely useful in cases of maniacal excitement. Often the bath, with a drink of warm milk at bed-time, suffices without hypnotics to produce sleep. But if hypnotics have to be given, the quantity required is less when combined with the baths. The hypnotics I recommend are trional, gr. x-gr. xv, preceded by mist. paraldehyde \mathfrak{z} ij, or this alone. Pot. brom. or chloral, of each 15 gr., and either tinct. opii \mathfrak{M} xv, or tinct. cannat. ind. \mathfrak{M} x. Dial two $1\frac{1}{2}$ gr. tablets. In maniacal excitement hyoscin in $\frac{1}{100}$ - $\frac{1}{75}$ gr. doses hypodermically. It is better to avoid drugs if possible, but sleep is indispensable. The next thing is to attend to the general bodily condition by nourishing, digestible, and easily assimilated food; and lastly, very important is attention to the primæ viæ, by which auto-intoxication and cerebral congestion can be relieved. A dose of calomel at night and saline in the morning is the

usual practice. The severe headache from which these patients suffer, requires relief by an ice-bag to the head, aspirin, phenacetin, and other drugs which relieve neuralgic pains.

After the patient has recovered from the more serious condition of shock, and the mind is becoming more alert and interested in its surroundings, we have to consider how best to allay the symptoms which nearly all suffer from, viz. headaches, dizziness, tremors, feeble circulation, and exhaustion readily brought on by mental or bodily effort. As a sedative and nerve tonic I usually prescribe dilute hydrobromic acid, quinine, and strychnine. I have found pituitrin useful in cases of low blood-pressure. When the symptoms point to hysteria, bromide and ammoniated tincture of valerian are prescribed. If the patient is sufficiently well to sit up, it is better that he should do so, at first for a few hours a day, if possible in the open air. To severe cases, the noise of gramophones, pianos, the click of billiard balls, and even musical instruments, excite and aggravate symptoms; quiet repose in single rooms, such as we have at the Maudsley Hospital, is undoubtedly a most important and necessary mode of treatment in the early stages of severe cases.

At the same time these patients should not be left alone; quiet and unstimulating diversion of mind should be encouraged to avoid introspection and dwelling upon the terrible experiences they have gone through. These men are often too tired or unable to read on account of inability to concentrate attention and fatigue of the muscle of accommodation, and the mind may be diverted by simple games, knitting or wool work, bead work, basket work, and net-making.

Mental Hygiene in Later Stages

As soon as they are better, patients are encouraged to play billiards, cards, and other games, in the winter time

especially; also there are frequent concerts and popular lectures, all of which serve to divert the mind and produce an atmosphere of cure, which is very essential. Soldiers will put up with a good deal provided they have good and abundant food, and it is essential for recovery that there should be no grouching.

Grumbling and grouching are contagious, and it is always well to get rid of a soldier from a ward if he is exciting discontent in the others. Discipline is very essential; laxity of discipline, over-sympathy and attention by kind, well-meaning ladies giving social tea-parties, drives, joy-rides, with the frequent exclamation of "poor dear," has done much to perpetuate functional neuroses in our soldiers. The too-liberal gifts of cigarettes has produced a cigarette habit in officers and men, which is highly detrimental in these cases of war neurosis, especially in cases of irritable dilated heart, and in other forms of cardiac neurasthenia.

Again, in many cases of functional paralysis the idea of a permanent disability requiring pension for the rest of a man's life may become a fixed idea, owing to wrong diagnosis, over-sympathy, and misdirected treatment. In many of these cases (as I have found) what is required is merely strong suggestion to the patient that there is nothing the matter with him except the idea that he is paralysed, which has become installed and firmly fixed in his mind by prolonged bed, daily massage and electricity, suggesting to him that there is an organic disease causing his complaint. I have seen many cases of inability to stand or walk, who yet could move their legs in bed, and by the tests I have described exhibited conditions definitely pointing to functional paralysis and not to organic disease. Being thus sure of my ground, I have told the patient to get up, and I would support him and see that he did not fall. I have then engaged his attention by asking him questions about himself and his former life while gradually relaxing my hold, until he was standing without any support.

After a little while, I say to him: "Now, you did not know that you have been standing about five minutes without any support." I have often succeeded in making such a patient walk. Men have come who have been using crutches for a long time, and I have told the sister to take the crutches and put them in the museum, for this patient did not want them.

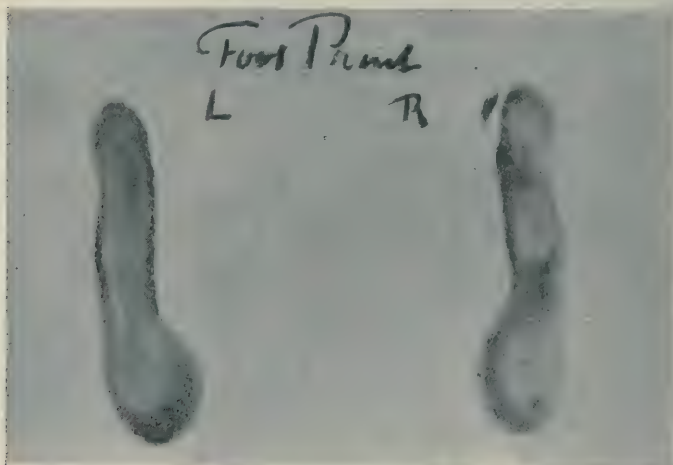


FIG. 72.

Treatment of Hysterical Paralyses, Contracture, Mutism and Other Disabilities

I have found it useful to explain to an officer or an intelligent soldier the fact that in bilateral associated movements, such as in swimming, or raising the arms above the head to seize a horizontal bar, one half of the brain will initiate the movement in both upper limbs, and that, inasmuch as the one arm is paralysed because the opposite half of the brain has lost voluntary power over it, that these associated movements will revive the function (*vide* Figs. 35, 36). Probably he will be interested and his attention will be directed towards the process of re-education. I then



FIG. 73.



FIG. 74.

FIGS. 73, 74.—This patient was admitted giving the following history. Eight months previously in France he had suffered with a slight frost bite of the heel, and he had been in hospital since. He had developed a double talipes equino-varus and a spastic extensor functional paresis. He had been provided with crutches. There was a leather pad on the inner side of the sole of each boot and springs on the outside to correct the deformity. The crutches and boots were taken away, and he was told he would want them no more. The two footprints (Fig. 72) were taken, and the two feet were photographed (Fig. 73), showing well-marked inversion with extension of the toes and some extension of the ankle. The feet were manipulated and re-education was commenced. He was told to walk on the re-education footprints, taking care that the sole of the foot was planted flat on the ground so as to cover the footprint up. After an hour's treatment by contra-suggestion and re-education the second photograph (Fig. 74) was taken, showing that the patient was cured. The obvious reflection is, why had this not been done before?

perform a number of associated movements of the two arms together, the healthy one and the paralysed; myself assisting the immobile arm, telling the patient to help me by thinking of the same movement. After a little while he may be doing the main part of the movement himself.

When in addition to paralysis there is a contracture and deformity, *e. g.*, in long-standing talipes equino-varus, I have found the following procedure effective. Continuous passive movements (kept up for hours on successive days) to overcome the deformity by fatiguing the group of muscles which are in a state of permanent contracture. This procedure no doubt acts by suggestion, and mechanically by fatiguing the group of muscles that are the cause of the deformity.

It may be necessary in protracted, long-standing cases of contracture and paralysis to give an anæsthetic to break down the adhesions in the joints. For a few days after the parts may be swollen and painful. Massage and passive movements, telling the patient at the same time to think and will the movements, are very useful in restoring the nutrition of the muscles and voluntary power. Faradism of the muscles, showing the patient that they contract and explaining to him that this is a certain proof that the limb is not paralysed, is a very useful form of suggestion. Another useful method of suggestion applicable especially to flaccid paralysis of the arms is to tell the patient to shut his eyes and reproduce all the movements in the healthy sound limb that I make in the paralysed limb. If he does this I feel confident of a good result. I tell the patient that I have obtained definite proof that his brain is in connection with his paralysed limb, and that all he has to do is to will the movements which I am making and he will soon feel his muscles contracting.

When there is acrocyanosis and hypothermia I explain to the patient that this is caused by the immobility, and that just as the hand which is benumbed by cold becomes

useless, so upon restoring the circulation by friction and warmth the feeling and usefulness of the hand returns. I therefore tell him that we shall restore the warmth and circulation in the hand by radiant heat, by massage with the vibrator and passive movements.

It has occurred to me that the vaso-motor paralysis that causes the acrocyanosis in a part psychogenically immobilised for a long time can be explained physiologically by a lapse in the habitual automatic association of the cortical sensori-motor centres, presiding over bodily structures, with corresponding autonomic centres that control and regulate their blood supply in accordance with their functional activity. When the muscles are for a long time inactive the blood supply is only sufficient to provide for their nutrition. A vicious circle tends to be established, for the muscles being inactive and cold, kinaesthetic and other sensory stimuli from the superficial structures no longer excite the brain. The sensori-motor centres in the brain, like the hand, are benumbed.

The Atmosphere of Cure

Nothing excites faith so much as seeing the benefit of treatment. A special treatment room is set apart in the Pathological Department of the Maudsley Hospital, and the large adjoining library is used as a waiting-room. Here are gathered not only numbers of patients from the Maudsley Hospital, but numbers of others sent from other hospitals for treatment. A soldier deaf, mute or paralysed who comes out of this room, as they almost invariably do, hearing, talking, and walking makes a deep impression on the minds of comrades waiting their turn to be treated for similar functional disabilities.

I reproduce here a notice fixed on the door of the special treatment room; it was spontaneously designed, executed and placed there by a grateful sergeant who had been

cured of a functional paralysis which had supervened on the basis of an organic spastic paralysis (Fig. 75).

Having thus by one means and another obtained the faith of the patient, it does not matter much which method of counter-suggestion is employed. As a rule the physio-psychic is the most certain and expeditious, but selection of method is the best procedure to adopt, for I have found one method succeed where another has failed.

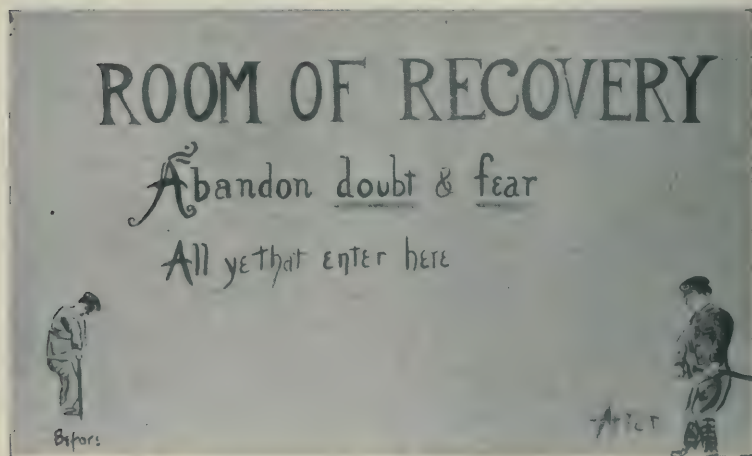


FIG. 75.—The room of recovery.

The paralysis or contracture having been overcome by counter-suggestion, the next thing is re-education.

1. *Hypnotism*.—I have seldom practised this method of treatment, and it has for the most part been given up, because of its uncertainty, and because of the relatively large number of relapses reported; not to mention the bad after-effects it has on some patients. Sometimes light hypnosis will enable the patient to bridge over a slight or moderate amnesia; some physicians also prefer to treat insomnia by light hypnosis rather than give potent narcotics, and in skilled hands it has met with success.

2. *Discipline*.—Military discipline is essential for the

satisfactory treatment of cases of functional neurosis. All patients should be made to salute officers and stand to attention when they enter the wards. Laxity in discipline and excuses for bad conduct should not be tolerated. In my judgment military discipline is very essential for the treatment of hysteria. No case should be discharged from the army with a curable functional nervous disability. He should be told that he will remain in the hospital until he is either fit to return to his command dépôt, placed in a category, or discharged. If discharge is recommended I require that some ability for occupation should be shown, and the patient is asked to obtain a letter from his former employer stating that he is willing to take him back and to give him light employment.

A man discharged from the army suffering with mutism or hysterical paralysis, and receiving a pension is likely to remain mute or paralysed. It is a mistake to grant pensions or gratuities to purely hysterical cases, as it tends to perpetuate the functional disability. Hysteria is often confused with neurasthenia; it is easy to cure the hysteria, but the neurasthenic symptoms persist, and such cases require longer treatment.

3. *Simple Re-education.*—This is a relatively slow and tedious process which is almost impractical now, when there are so many cases to treat and so few physicians competent to treat them. Here, as in every method of treatment by suggestion, the patient is just told in simple language about his disability and its causes and what to do for their relief; and he is given some simple examples of similar conditions in everyday life. He is then shown why he cannot perform some simple movements, articulation, etc. In the case of functional muscular paralyses, passive movements are first made in which the patient learns to overcome passive resistance. Later active movements are attempted, continually showing the patient where and why he fails to perform these correctly. He soon

begins to improve, and continued practice under strict supervision completes the cure after a long or short period. With this method one must be careful not to produce too much fatigue in the patient, as poor results, possibly due to accumulation of fatigue poisons, are probably produced in a certain percentage of cases where intensive exercising is contra-indicated, *e. g.*, in cases which have been bedridden for a long period, or in the emaciated.

4. *Re-education reinforced by Electricity.*—By this method cures are produced very rapidly in practically every case of hysterical (pithiatic) disorder. The secret of the success with this method is just to proceed as in the simple re-educative method; ascertaining just what the patient can do, and then explaining exactly the reason for applying the faradic electricity. Then the patient is put at his ease and told that he will not suffer pain during the treatment. A very mild faradic current is first applied to the affected parts; at first not strong enough to produce contraction of the paralysed muscles, later becoming stronger and stronger until there is a lively contraction in the affected group with each make

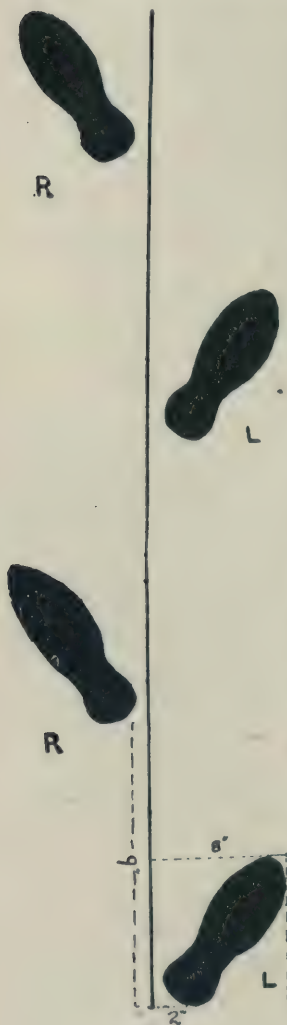


FIG. 76.

and break of the current. It is well during the treatment to produce contraction of paralysed muscle groups, or to

faradise the antagonists of contracted muscles sufficiently to overcome the disability, the patient during the gradual release of the current being encouraged to exercise his own mental control of the same.

5. *Re-education by Exercises.*

—The different abnormal gaits depend for cure more upon re-education than upon other forms of suggestion, the physician's sympathetic but firm encouragement, and corrective instruction to the patient being essential for success. A great deal of patience and endurance of both instructor and instructed are required in the treatment of these disabilities. The patient, having been shown that all his muscles contract when stimulated, is told

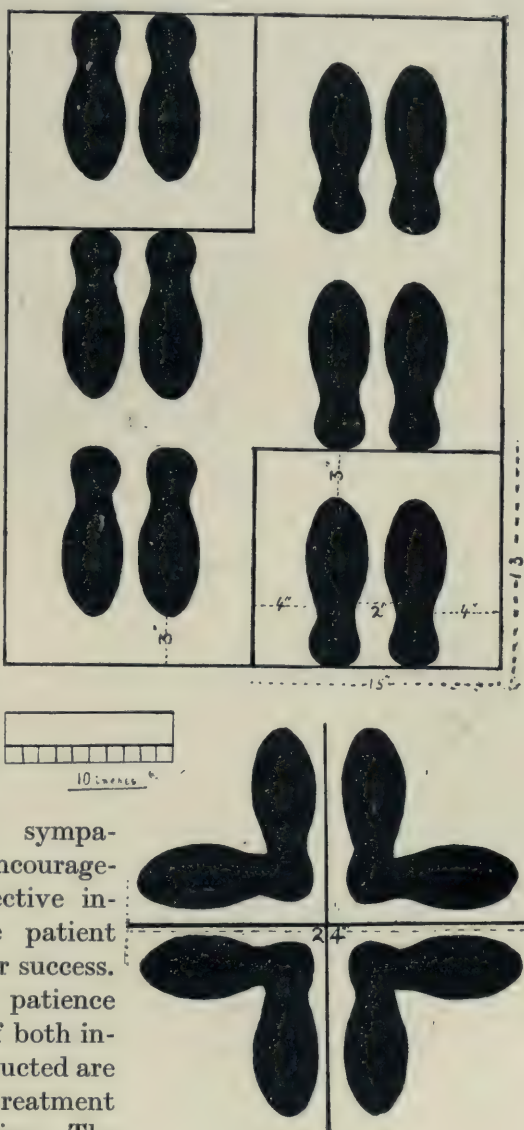


FIG. 77.

to stand to attention. As in many of these patients, the sole of the foot is shuffled along the ground; he is told to do the goose-step, bending the knee of the advancing foot fully, then extending it and pointing the toe before the sole of the foot is placed firmly on the ground. He is kept at this until he does it well. He is then taken to footprints of a normal person (painted on the floor) and instructed to walk, seeing that his feet cover each footprint. He is then required to perform the more difficult exercise of covering the footprints by crossing the advancing leg over the resting (*vide* Figs. 76, 77). The disability of gait and station, caused by a coarse hysterical tremor or shaking, may be cured by the same method of suggestion and re-education. After the patient has been cured he is required to attend daily the class for convalescent cases.

Exercises for Convalescent Cases of War Neurosis

1. *Breathing* through the nose, filling the chest and slowly but steadily expelling the air through the nose. The same, accompanied by raising the arms above the head with deep inspiration, and bringing them down to the side in expiration.

2. *Neck* (counting four).

- (1) Chin forward.
- (2) Chin back on chest.
- (3) Chin to the right shoulder.
- (4) Chin to the left.

3. *Shoulder* (counting three).

- (1) Lifting right shoulder and letting it drop by its own weight.
- (2) Lifting left shoulder and letting it drop by its own weight.
- (3) Lifting both shoulders and letting them drop by their own weight.

4. *Arms* (counting three).

- (1) Arms pushed forward, hands closed.
- (2) Arms back as far as possible and in line with shoulders.
- (3) Arms bent, hands open and touching shoulders.

5. *Back* (counting four). Legs apart and kept stiff.

- (1) Bending spine forward as far as possible, arms extended and reaching down as far as possible.
- (2) Bending spine back slightly.
- (3) Bending spine to the right.
- (4) Bending spine to the left.

6. *Legs*.

- (1) Hopping on right leg.
- (2) Hopping on the left.
- (3) Hopping on both.

7. *Stationary running*.

These exercises, when properly performed, show the mobility of all the joints of the body and any disability is readily detected.

Each exercise is repeated twenty times.

Treatment of Hysterical Sensory Conditions

In cases of anæsthesia a faradic brush or roller with gradually increasing current will (as a rule) effectively cure sensory disabilities in the space of a few minutes. A useful method of restoring sensibility in a part insensitive to pricking is to connect the needle with the movable electrode employed in faradisation.

He does not know when the needle will give the electric shock, and it generally awakens the dormant sensibility, so that the feeling of a prick without any current is soon restored.

Hysterical blindness is usually not difficult to cure when the patient has not become disheartened by failures through being handled incompetently. The patient being confident that he will get well, and being constantly reassured by the physician, has then a mild faradic current applied to the supra or infra orbital notch. The current is gradually increased until it becomes slightly painful; meanwhile, he is given the suggestion that he will gradually see shadows, then the outlines of objects placed before him, at first moving slowly and gradually more rapidly.

Deafness is treated in a similar way with the application of the current to the mastoid region or the external auditory meatus. The use of the stethoscope to the patient's ears as a means of suggestion, shouting in the ear while the current is passing, or the application of tuning-forks of different vibrations may be tried as a means of restoring the function.

Physio-psychotherapy in the Treatment of Mutism

The method employed is as follows: the patient, after a careful and thorough examination, is assured that he will be cured of his disability. If it is a case of mutism or aphonia, he is asked to produce sounds, to cough, to whistle, to say the vowel sounds, which he will probably not be able to do. The voice may return by suggestion only. But a more rapid method is to reinforce suggestion by the application of the faradic current to the neck by means of a roller electrode or brush. The current is increased in strength and very often the patient immediately recovers his voice and speaks. If he does not speak, he is again faradised with the roller or brush electrode and made to say, Ah, A, Ee, Oh, Oo.

Most mutes cannot speak because they cannot phonate; they cannot phonate for two reasons: (1) because the vocal cords remain motionless, (2) because the mute cannot control the breath. The voluntary adduction of the vocal

cords is inhibited; likewise the volition required to initiate and control the expiratory blast of air necessary to set them vibrating—the two essentials in phonation. A psychogenic perseveration of an instinctive fear reaction operating on the cortical centres presiding over the voluntary control of the breath in phonation causes a dissociation of those centres and consequent mutism. A sudden painful surprise suffices for an instant to arrest the unconscious psychogenic perseveration, and its dissociating influence is overcome by a cry, which is the natural instinctive reaction to pain; this gives us the clue to the influence of faradism and its mode of application in the cure of mutism. We have now to keep up this reassociation of the cortical centres of phonation and add to it (if still absent) the production of articulate sounds. We make the patient say the days of the week, the months of the year, and to count up to twenty. Records before and after treatment are frequently taken on the dictaphone, and mutes are allowed to hear these records before treatment to encourage them.

By such treatment hysterical mutes have been invariably cured at one sitting.

Treatment of Stammering and Stuttering

Stammerers, stutterers, and patients who repeat syllables or words in a jerky and tremulous manner may be similarly treated, but as a rule, especially if they have stammered in pre-war times (as many have done), careful and daily repeated exercises, first consisting of breathing lessons, are required. Patience is necessary. They are told to close their mouth and take a full breath through the nostrils, and then blow out in a steady blast through the hands held up to the mouth like a trumpet. As soon as they blow in a steady stream they are made to produce the vowel sounds in the middle of the register, great care being taken to see that the patient produces these sounds without tremor or jerkiness. It is well known that the person

who knows how to control the breath has acquired the fundamental principle in the art of singing. If the patient is intelligent the action of the diaphragm can be explained to him. He may be told that the chest contains the lungs, which by their elasticity expand mainly by the descent of the diaphragm when air is breathed in, and that this air can be forced out in a steady flow through the windpipe by the diaphragm being made to act like a piston in the barrel of a syringe. The lungs then constitute the bellows of the vocal organ in speech and song. But the air as it is forced out in a steady stream through the chink of the glottis sets the vocal cords vibrating, and this produces sound. The pitch of the sound depends upon the rapidity of vibration of the vocal cords, and this is regulated by muscles that stretch and approximate them. The loudness depends upon the force with which the air is driven against the vocal cords, and the evenness of tone depends upon the steadiness with which the air is expelled from the lungs. Consequently, both the loudness and the steadiness are regulated by a force which presses upon the diaphragm and forces it up so that the air is expelled from the lungs. Now, this control of the breath is effected by the will acting upon the abdominal muscles in such a way as to act like the force which blows the bellows of an organ. Re-education, then, consists firstly in the acquirement by practice of the control of all the muscles which expel the air from the lungs.

Many of these speech defects are caused also by a lack of correlation between this control of the breath by the bellows and the modification of the sound by the articulatory mechanism of the tongue, the lips, the jaw, the teeth and the palate in the production of the consonants. A tremor of speech in cases of war neurosis is often due to a tremor of the lips, and this shows itself especially in the lip explosive consonants M, B, P. Subjoined is a useful table taken from Wyllie for testing the progress of re-education in stammerers and stutterers, etc. Fear and apprehension

inhibit the normal automatic correspondence of the two mechanisms, the control of the breath and the modification of the sounds by the articulator mechanisms. For re-education of the stammerer and stutterer, I make the patient utter the first simple vowel sound and then place the consonant in front, lastly the rest of the word. Thus in Peter : e-Pe-ter, Peter; Brown : Bur-own, Brown. The great secret of success is patience on the part of the instructor and perseverance on the part of the patient.

PHYSIOLOGICAL ALPHABET (WYLLIE)

l Vowels	i Eels	e Ail	a Amid	o Ocean	u Ooze
	Initial Y closely related to i, yes.				
	" W " " u, weary.				
	Voiceless oral consonants.		Voiced oral consonants.		Voiced nasal resonants.
<i>Labials</i>	Peter		Brown		Made
<i>1st stop position</i>	(W)hite		Wax		
<i>Labio-Dentals</i>	Fine		Villages		
<i>Linguo-Dentals</i>	Thinkest		Thou		
	So		Zealot		
			zh		
<i>Anterior</i>	She		Leisurely		
<i>Linguo-Palatals</i>	Took		Down		Nine
<i>2nd stop position</i>	(L)		Large		
			Roses		
<i>Posterior</i>	K		G		Ng
<i>Linguo-Palatals</i>	Can		Gilbert		Bring
<i>3rd stop position</i>	Loch Hourn		Youths ?		
	Fricatives.		Fricatives.		Resonants.
3	Far	2	We	4	My Nephew
	Shores		Visit		
	Seem		Thee		
	Thinly		Zulus		
	Hazy		Like		
			Ramblers		
			Yearly		
6	Explosives.		Explosives.		
	Two Poor Comrades		5 Best Gold Dust		

NOTE.—Stammering. Numerals, give order of difficulty.

- | | | |
|--|---|-----------------|
| 1. Mother make more mustard. No, no ! not now. | } | Test Exercises. |
| 2. Billy Button bought a buttered biscuit. | | |
| 3. Davy Doldrum dreamt he drove a dragon. | | |
| 4. Gaffer Gilpin got goose and gander. | | |
| 5. Peter Piper picked a peck of pepper. | | |
| 6. Tiptoe Tommy turned a Turk for twopence. | | |
| 7. Kimbo Kembel kicked his kinsman's kettle. | | |

Physio-psychotherapy in the Treatment of Paralysis and Analgesia

If the patient suffers with paralysis the muscles are made to contract by applying the electrode to the points necessary for exciting the appropriate nerves. He is then told to look and see that the muscles all act in response to the stimulus, and he is assured that it is only his will that refuses to act. The brush or the roller is again applied, and he is then told to move the paralysed limb; if he does not do so, the current is applied until he does. For example, suppose we are dealing with a case of functional paraplegia; after applying the current he is told to raise the limb from the couch, to bend and straighten it and successively told to perform movements of all the joints in both limbs. Having accomplished this, he is then told to stand up to attention; should he make any indication of falling, the current is applied to the buttocks or some other part of the lower extremities. Next he is told to walk, and the stimulus is applied, if necessary, to make him do so, and finally, if he is not a long-standing case of functional paraplegia, he is induced to do the goose-step, and finally he is stimulated to run. There is often a functional analgesia of the gauntlet or stocking distribution. This may generally be easily removed by the following method. The patient is pricked with a needle, and if he says he does not feel, I then pass the needle through, or connect it with the movable electrode in the circuit of the faradic current. I prick him again and he will probably feel, for the stimulus will be pretty strong. Very soon he will feel well the prick of the needle when no current is passing through it. Where there is analgesia it is advisable to remove this by physio-psychotherapy before treating the paralysis.

Freud's Theory of the Unconscious in Relation to the Treatment of War Psycho-neuroses by Psycho-analysis

The special characteristic of Freud's theory of the unconscious is an active repression of a painful experience, and his doctrine of the part taken by such repressive experience in the production of bodily and mental disorder is the principal feature of Freud's theory in its relation to the psycho-neuroses; for many morbid mental and bodily states are, according to Freud, due to a conflict between repressed experiences now usually called complexes and the general personality or ego of the sufferer.

Freud, and more especially his followers, have only seen the sexual aspect of the theory, and they have regarded sexuality as its sole basic principle. But the experience gained since the war shows that this position is no longer tenable.

Psycho-analysis claims to uproot the "complex" from the subconscious mind and to bring it back into consciousness, when it can be influenced by persuasion and reason.

Psycho-analysis by Word Association

Stimulated by Bleuler, Jung and Riklin examined many educated and uneducated persons by giving them a hundred stimulus words for association with other words and noting the reaction time. That is to say, they take a series of one hundred words; each word is read out clearly by the examiner, and the patient is asked to call out the word which (recalled by association) first comes into his mind; the time intervening between the pronouncement of the word by the examiner and the pronouncement of the associated word by the patient is measured by a stop-watch recording one-fifths of a second. The following formula is employed:—

STIMULUS WORD.	ASSOCIATED	TIME.	REPRODUCTION.
	REACTION WORD.		

The average reaction time is generally 2·4 seconds.

Before the experiment is begun, the person to be tested is instructed to concentrate his attention upon the experiment and always to call out immediately the first word that comes to his mind. The answer as well as the reaction time are carefully noted, and after the whole series of one hundred stimulus words has been read out, they are again repeated and the patient is asked to repeat the original answers, which are again noted with the intervening time; and if another word than the first association is reproduced it is noted. Whenever there is an impediment to the reaction and a prolonged time interval between the calling out of the word and the production of the associated word, we are in possession of a fact pointing to a possible complex.

Jung claims that all apparently adventitious mistaken delays in reaction time in the association experiment have a definite reason; and that, contrary to the belief of the person tested, his answers may betray his inmost thoughts, or at any rate afford a clue to them.

This method may therefore be applied successfully in certain cases of neurasthenia suffering with an anxiety-neurosis. Officers, and sometimes men, who are reticent regarding the mental conflict underlying the neurosis by which they are afflicted, are often found quite willing to co-operate in what they not infrequently regard as a sort of game or mental exercise for treatment which has little or no relation to the discovery of the cause of their anxiety.

But as soon as the examiner has correctly interpreted the delay in association, found the complex, and predicted the repressed painful experience causing the mental conflict underlying the state of anxiety, the patient's faith in the method is aroused, and he will be induced to open up and talk freely.

Needless to say, the examiner requires not only to carry out the experiment in a judicious and careful manner, but also judicially to interpret the findings. "When the causes

for the anxiety have been satisfactorily elicited, the next process is to endeavour to rearrange them so that their original effect is no longer produced. In practice this mainly consists in making clear to the patient the real significance of the memories, fears, apprehensions and so forth, reducing them to their proper perspective, and thereby adjusting the conflicts and internal stresses which underlie the symptoms. Much of this may be described as common-sense illuminated by a technical knowledge of psychology, but the technical knowledge is an absolutely indispensable adjunct.”—Bernard Hart.

The Galvano-psychic Method of Investigation

Veraguth was the first to utilise the galvano-psychic method of revealing repressed complexes. The method was pursued further by Jung and Petersen. Instead of taking the time reaction with a stop-watch the reflecting galvanometer was used as the indicator. The procedure of Veraguth is followed in the main on patients at the Maudsley Hospital.

The patient is seated in the chair, and when quite mentally composed and adapted to his surroundings, a constant current of 2·8 volts is passed through him and balanced by means of a Wheatstone Bridge with an Ayrton-Mathus moving coil galvanometer suitably shunted. Instead of the solid electrodes hitherto used, the hands of the patient are plunged into two bowls containing warmed 2 per cent. saline into which dip zinc electrodes. It has been found that by this method alterations of resistance due to movements on the part of the patient are reduced to a minimum, and the total resistance is reduced to about two to three thousand ohms.

The diminution of resistance constituting the psychogalvanic response is recorded when it occurs and noted.

A series of words is then read out, a definite interval of time between each being allowed. The latent time in

answering is recorded by a stop watch, and it is found that there is a rough correspondence between length of latent time and the intensity of the psycho-galvanic response. The latter has been found to be much the more reliable as an indication of the existence of an emotional complex. A semi-automatic word response may often be given within normal time limits, and a few seconds later the associations aroused by the stimulus word are awakened and manifested by a diminution of resistance opposite the stimulus word. In the case of words causing an emotional reaction, there is deflection of the beam of light in a certain measure proportional to the emotional effect, for the resistance is diminished owing to the increased functional activity of the sweat glands and to the vasomotor effects in response to the emotional disturbance.

The series of words is repeated, and the reaction is again noted. Those stimulus words which gave a marked reaction are analysed with a view of interpreting an anxiety complex. The patient's reaction is again observed when the complex, believed to underlie his anxiety state, is predicted by the examiner.

Professor Waller has shown the psycho-galvanic method to be of value also in determining a state of emotivity of a patient who is suffering from neurasthenia following shell shock. Thus a loud noise produced near the patient causes a marked reaction; likewise the menace of a burn in a man who is in an emotive state whether constitutional or acquired.

This method in the hands of a skilled operator opens up possibilities in the diagnosis and prognosis of the war-neuroses and in the detection of malingerers, but it can only be applied by those few who have at present the necessary knowledge and skill to avoid technical fallacies and the judicial mind correctly to interpret the facts observed and correlate the same with clinical experience. Moreover, it appears possible that it might be used as a

corrective to the interpretation of word-association, as the experiment itself is in no way influenced by the mind of the observer; thus if the complex discovered by the examiner using this method of word-association is the real cause of the anxiety; the casual relation in conversation of the complex should immediately reveal a marked galvano-psychic reaction, and no other suggested complex should produce such a marked effect.

It is necessary to say, however, that the instrument is extremely sensitive, and only long and patient observation can be regarded as likely to be productive of reliable results. It is accurate when the word-association is not.

The Reaction of the Neurasthenic and Hysteric Contrasted

Captain Golla has shown that the psycho-galvanic reaction of the hysteric presents a marked contrast to the reaction of the neurasthenic. In the hysteric there is a lowered sensibility generally, and in some particular systems so great is the psycho-sensory dissociation as to cause a loss of function; thus we may have deafness, blindness, or absence of the kinæsthetic sense, and aphonia, mutism or paralysis may result.

The hysteric who shows a psycho-galvanic reaction less than the normal may, however, exhibit during the experiment a spurious excessive emotional reaction by respiratory manifestations. In fact, it is a subconscious emotional simulation.

It is well known that hysterics are easily moved to tears or laughter, and the two may be almost simultaneous, showing that there is no depth or intensity of feeling. "The silent grief that whispers the o'er-fraught heart and bids it break" does not enter into the hysterical complex.

The psycho-galvanic reaction of the neurasthenic suffer-

ing with an anxiety neurosis presents a psycho-galvanic reaction to noises, to pain and to certain word complexes which have a relation to his anxiety, much more marked than in the normal individual. The psycho-galvanic reaction may therefore in the hands of an experienced observer be a useful aid to diagnosis and prognosis.

Captain Golla, working in my laboratory, has shown that there is a difference in the ergograph tracing of the hysteric, the normal and the neurasthenic. This is well illustrated in the tracings. The hysteric does not show fatigue, because the pull is much below the normal; the neurasthenic differs from the normal in showing the advent of fatigue much sooner than the normal.

It is remarkable that the hysteric's pull by the sound limb is considerably less than normal and less than can be explained by the condition of his muscles. This fact suggests that there is an innate volitional weakness, so that a slight emotional shock may cause cortical kinæsthetic dissociation and return of the paralysis.

Fatigue does not show itself in the ergograph tracing of the hysteric, because he has not the will to exert himself. There are variations in tension, but these are not evidences of fatigue.

Test of Memory and Responsibility in Officers Suffering with Neurasthenia

The following orders, which an officer might have to carry out, are read to him slowly, and he is allowed to write the same down, or he may write notes. He is then questioned upon the nature of the order. If he makes a mistake in any important essential he is easily convinced that he is unfit. This test is very useful when applied to officers who have not recovered sufficiently and who are anxious to get back to the front, for they see then how useless they would be and that they are quite unfit for any responsible position.



A. Initial pull 95 lbs. Tracing from normal man exercising maximum contraction of hand on dynamometer. Contraction curve shows progressive diminution, and is fairly smooth.



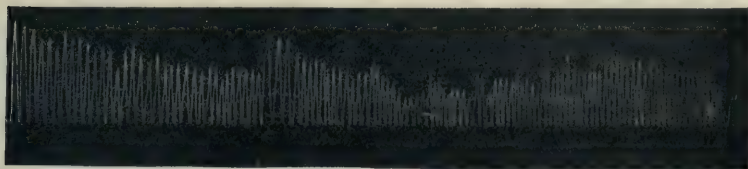
B. Initial pull 65 lbs. Normal man not exercising full power owing to stiff finger joint. Note absence of fatigue curve and rhythmic oscillations of attention.

LEFT-HAND.

RIGHT-HAND.

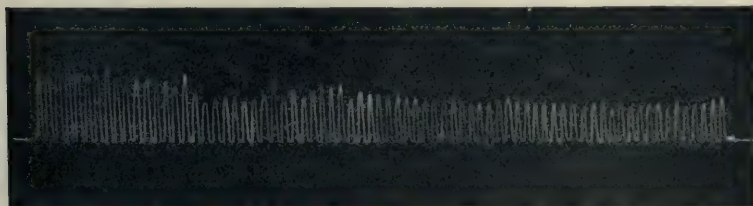


C. Left-hand pull 10 lbs.; right-hand pull 50 lbs. Case of hysterical monoplegia of left-hand. The left-hand shows no fatigue curve. The right-hand shows typical diminution of power, only 50 lbs., and irregular oscillations. No fatigue decline, as full power not exercised.



ADMONISHED.

D. Initial pull 85 lbs. Maligner. Note irregularity of fatigue curve. Spurt put on when admonished. Rapidly decreasing again.



E. Initial pull 50 lbs. Neurasthenic. Note small initial contraction with rapid subsidence to small contraction, which is kept fairly level.

24. x. 1918.

2ND-LT. SMITH.

I/c of Night Raiding Party.

Your party will be at Assembly pt. A 7.5 by 22 hrs.
24. x. 1918.

At Zero + 12 you will advance in formation already communicated and perform task already given. Care should be taken that all wounded are evacuated, and time of barrage dropping memorised.

Acknowledge receipt of message and please destroy after perusal.

O. C. NIGHTLIGHT.

By runner.
13 hrs. 15.

25. x. 1918.

2ND-LT. BROWN.

Your party will parade in time to reach C 1.5 by 23 hrs. 40.

The work of destroying enemy saphead and method of conduct have already been given to you at our conference this morning.

Should unforeseen circumstances arise, you will, of course, use your own initiative, although it may involve changing the whole method of conduct of operation.

Impress upon your men, the last thing, that firmness of purpose, strict silence, and daring and audacity go far to make these local operations a true success in the military sense.

Acknowledge receipt, please, and destroy after perusal.

O. C. NIGHTLIGHT.

By runner.
15 hrs. 60.

OPERATION ORDER NO. III, "Z" ARTILLERY GROUP
22/4/16.

The 21st Division will attack and capture Pink Line on 18th May, 1917. Zero hour has been fixed for 14.40.

"Z" Group. Eighteen-pdr. batteries will provide a creeping barrage to cover infantry attack in 50-yard lifts

every minute, and a standing barrage to protect infantry when in occupation of Pink Line, as set forth in table below.

Task I. All 18-pdr. batteries.

Angle of sight 10" dep., range 4200, No. 80 fuses. Length of fuse, 20½.

Zero to Zero 15. Six rounds per gun per minute, lift 50 yards every minute.

Zero 15 to 40. Four rounds per gun per minute, 50 % H.E. to be used.

Zero 40 to 50. Three rounds per gun per minute, 50 % H.E. to be used.

Zero 50. Stop, await orders from Group Headquarters.

J. SMITH,

CAPT. and Adjutant,

"Z" Artillery Group.

I have records of these orders and others upon the dictaphone, and the officer is asked to listen to the same, make notes, and be prepared to remember how to act.

The Gymnasium in Treatment after Functional Paralyzes and Contractures

I am sure that machines employed by doctors as a means of making the functional paralytics move their limbs are wrong in principle and in practice, and I entirely approve of the methods adopted by Col. Deane at the Croydon Hospital of restoring function by natural methods, in which the mind is exercised. The value of natural and varied associated movements, such as we get with the parallel bars, the climbing rope, skipping, basket football, punching ball, Indian clubs, the nautical wheel, and the ordinary apparatus of the old-fashioned gymnasium in the treatment of convalescent cases of functional contracture and paralysis cannot be over-estimated. For these exercises have this advantage over machines which move the disabled limb in the fact that the mind is projected into the

paralysed limb, and all the sound limbs are being exercised at the same time.

Another advantage of the gymnastic class is emulation; for the effect on the mind of seeing one man perform an exercise is to stimulate another to do better. The reader for further information is referred to a little book by Col. Deane on *Gymnastic Treatment for Joint and Muscle Disabilities*.

After-treatment by Occupation

Diversion of the mind by useful occupation in the workshop, in the garden, and on the farm, have been most successful in restoring health and strength to functionally disabled men.

Now, before discharging soldiers suffering from these functional neuroses as permanently unfit, always tell them that they must show themselves fit to be discharged, by having so far lost their symptoms that when they do return to civil occupation, people should not say, "What are those blessed doctors doing in discharging a poor fellow in a condition like this?"; and before they can leave the hospital they must give evidence of being in a fit state. I tell my patients that I will prescribe for them two hours' occupation in the morning in the carpenter's shop. This treatment I have been enabled to carry out through the generosity and kindly interest of Lady Henry Bentinck, who, at her own expense, has built in the grounds at Maudsley Hospital a large workshop fitted with every appliance for carpentering, cabinet-making, and metal work, and with a first-rate instructor. Numbers of officers and men are daily employed in this workshop, and almost daily Lady Bentinck comes to encourage them by her presence, and to supply any need for the successful prosecution of the work. The War Office pays for nothing.

The Maudsley Hospital is situated in extensive grounds (for London), and the soldiers, under my direction, did much to beautify the waste that followed the building

operations; they have even made a fountain and flower-beds. I utilised a large amount of the garden for growing vegetables. Among other occupations to be encouraged may be mentioned that of poultry keeping.

As soon as the men show that they are fit to undertake light work, we feel that they are sufficiently recovered to be discharged from the hospital under the new Army Council Instructions, No. 712 of 1918 (*vide* p. 260), but very often we find they suffer from dizziness or they easily tire, or say they suffer from dizziness or tire; but those who are too ill to undertake any work should be considered too ill to go out on pass. In the carpenter's shop the men receive such remuneration as the sale of the articles they make, less the cost, brings in; orders for handicraft are received by the instructor. Interest in the work is thus maintained, which is essential for success in treatment. There are patients, however, who cannot stand the noise of the hammering and tapping, and for such cases other occupations, such as shoemaking, bookbinding, etc., should be provided.

Singing classes, under the direction of proper instructors, have been a great success in France and in the camps in England. The Y.M.C.A. have organised a system which might with great advantage be applied to convalescent soldiers. Choral singing of good music would, I am convinced, prove for convalescent soldiers an uplifting mental diversion, which by promoting cheerfulness and healthy recreation could not fail to beget that sense of well-being so essential for mental and bodily recuperation. It would be not only of educational value to the soldiers, but in after life the acquirement of the art of singing would be a source of joy to themselves and pleasure to others when they return to active service and civil life. The Vocal Therapy Fund has been started to provide teachers of singing, and has already commenced to do useful work in hospitals and convalescent camps in England.

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APPENDIX

INTRODUCTION.—With the cessation of hostilities there has been, as anticipated, a remarkable drop in the number of recent cases of war neurosis, especially of mutism, aphonia, functional paralysis and contractures. There are, however, still in hospitals, convalescent camps and regimental depots a number of uncured cases. Still more numerous are the pensioners suffering with these curable disabilities; some of the cases which have recently come under observation at the Maudsley Hospital and have been rapidly cured had been receiving pensions for many months to several years. Many of these functional disabilities were associated with wounds and injuries. Although the examination of the patient with a view to differential diagnosis of functional from organic disease has been already discussed, yet my recent experience of pensioners has shown that a great many cases of war neurosis are associated with injuries and wounds; it has therefore become necessary, in awarding pensions, to ascertain how far the disability or deformity is due to the injury or wound causing an organic lesion of a more or less permanent character. For this reason it is felt desirable to summarise briefly, in the form of an Appendix, the methods that should be employed in making a systematic examination of such cases.

Diagrams, after Erb, of the motor points for electro-diagnosis and illustrations of the distribution of the peripheral sensory nerves, copied from the admirable work of A. Benisty, are given to aid the reader in making a thorough

clinical investigation of the neuro-muscular system and thereby to arrive at a correct diagnosis of the cause of a disability and deformity, and its permanence or partial permanence.

METHOD OF EXAMINATION

1. *Pre-war History of the Patient.*—The importance of ascertaining the existence of an inborn neuropathic or psychopathic tendency by a careful inquiry into the family history has been already emphasised in discussing the subject of war neuroses, but it may be pointed out that such information is especially necessary for determining how far the disability is due to a constitutional condition, therefore not attributable to, or aggravated by, military service. Again, it is necessary in the award of a pension or a gratuity to elicit facts in the history which may point to the existence of a disability or nervous disease prior to the patient having joined the service. The mental capacity may be, in a measure, judged by the standard reached in the board school, the occupation, and the wage earned prior to military service.

2. *The Military History.*—To ascertain this, the following questions should be asked :—

Length of service ?

When called up ?

Previous service or occupation ?

Did the patient join voluntarily or was he conscripted ?

Length of service abroad ?

Nature of the service ?

The most useful information is obtainable from the soldier's field-card. In the case of war neuroses and shell shock, the information regarding the nature of the case may be accepted as accurate, for the diagnosis is made by a neurologist first hand; any statement made by the patient that does not accord with it may, as a general rule, be disregarded. In cases of wounds and injuries of

the body associated with paralyses and contractures, the following particulars should, if possible, be ascertained :—

(a) *Details of the Injury*

When it happened ?

How it was caused ?

What were the immediate results ?

Especially was there loss of consciousness or collapse ?

Was there paralysis or loss of sensibility, and if so, what parts were affected ?

Was he able to walk to the C.C.S. ?

Was an operation performed ? Was the bullet or piece of projectile removed ?

Was an operation of nerve suture performed ?

Was there a fracture ?

If so, was it put on a splint, or put up in plaster, and for how long ?

Was anti-tetanic serum given, and if so, when ?

(b) *Subsequent History*

Inquiries should be made regarding the occurrence of secondary hæmorrhage, suppuration, and if any further operations were performed.

If the paralysis or contracture came on some time after the injury, the examiner should try to elicit a cause, mode of onset, and subsequent progress, stationary condition or retrocession.

Was a skiagraph taken, and if so, what was the result ?

If there is a joint fixation, its probable cause and development should be inquired into, also whether the after-treatment of wounds by splints, massage, etc., was without skilled surgical supervision.

The existence of trophic, vaso-motor and secretory disturbances should be investigated as to their onset and progress, and especial attention should be given to the

atrophy of muscles, and the length of time the patient has used crutches or sticks, or appliances to correct a deformity.

EXAMINATION OF THE PATIENT

The attitude, gait, station and sitting posture of the patient should be noted when he is aware and unaware that he is being observed. Also when he is undressing and dressing, for valuable information regarding simulation and exaggeration can often thus be obtained. The facial expression, and any abnormality in speech, should be recorded. The condition of the pupils, regarding size, inequality, irregularity and reactions to light and accommodation should be observed as a matter of routine. The existence of ocular paralysis and evidence of nystagmus are also important indications of organic disease and should lead to further neurological investigation, including ophthalmoscopic examination.

In many cases the history may show that the patient should be partially or completely stripped, and a careful inspection of the body made for scars of healed wounds, fractures, dislocations and deformities.

The relation of cicatrices, of entry and exit in cases of gunshot wounds, to the anatomical situation of nerves and the possibility of their severance or injury, should be determined. Again, the involvement of muscles, and particularly of tendons in deep-seated fibrous induration in the neighbourhood of cicatrices, and the possibility of limitation of movement thereby, should be considered. In cases of fracture, not only must the disability of movement, and the deformity caused thereby, be taken into account, but the possibility of pressure on the nerve by callus. Limitation of joint movement may be due to a fracture, to dislocation, to arthritis, or to adhesions and fibrous changes in the contracted muscles and tissues around the joint from prolonged immobility.

MOTOR FUNCTION

The existence of muscular atrophy and fibrillary tremor should lead to further neurological investigations regarding the groups of muscles so affected. The contracture of the atrophied muscles should be tested by comparative palpation of the affected muscles and those of the opposite side, when movement is attempted or performed with and without resistance.

When there is muscular atrophy of a limb, the amount of wasting should be estimated by careful measurements, and a comparison of them made with similar measurements of the sound limb. The electrical reactions of the muscles on the two sides should be tested (*vide* Electro-diagnosis).

The mobility of the joint should be tested by active and passive movements (*vide* The Orthopædic Exercises). Should fixation of any impairment of movement be observed upon passive movements, the existence of arthritic changes must be considered and an X-ray examination should be made. It must be borne in mind that muscular atrophy and organic changes in and around the joint readily arise from prolonged immobility. A wounded limb without nerve lesion, which has been immobilised by the prolonged use of a splint, may be affected by a contracture and paralysis.

A systematic examination of the electrical reactions of the muscles, the application of tests to determine the functional integrity of the sensory nerves, and a careful investigation of the superficial and deep reflexes in such cases, will enable one to differentiate organic from functional disease. In cases where organic and functional conditions coexist, such an examination will determine how far the disability is curable by physio-psychotherapy; moreover, a judgment regarding the amount of residual permanent disability can be made, and compensation by gratuity or pension can then be properly assessed.

THE INVESTIGATION OF SENSIBILITY

The investigation of sensibility may be conducted by simple methods of testing, but to obtain accurate records patience is required on the part of the observer and the observed. It is advisable not to weary the patient, for it is necessary to have his attention to obtain reliable results. It may be desirable to make several trials before coming to a conclusion regarding the exact topography of the sensory defects. The patient's eyes should be closed, or he should be prevented from seeing the part which is being tested.

Objective Disturbances.—Cutaneous or superficial sensibility and deep sensibility should be tested. The former includes tactile, painful and thermal sensibility of the skin, and each should be tested in cases of wounds associated with paralysis and contracture. The cases of skin affected by a partial or complete loss of sensibility to stimulation should be mapped out with a dermatographic pencil, and the same denoted on a chart. When the chart is complete it should be compared with the accompanying diagrams illustrative of peripheral sensory distribution of the upper and lower extremities and of areas of sensory changes in lesions of the peripheral nerves. Injury of spinal roots will give a quite different distribution of sensory disturbance, and the reader is referred to the table opposite p. 176 for information thereon. For sensory changes in hysteria *vide* p. 181.

Tactile Sensibility.—The skin is lightly touched with a wisp of wool, a soft camel-hair brush, or the tip of the fingers. The patient is told that he will feel a slight touch, and he is to say "Yes" whenever he feels the contact. It is better to work from the normal to parts in which the sensibility to touch is diminished. A hypæsthetic area surrounds the area of complete tactile anæsthesia. In this area it will be found that the two blunt points of a pair of compasses can be separated for a

considerable distance and yet give the sensation of but one point. Besides observing whether a patient feels the tactile stimulus, we should ask him to localise it by placing the finger on the point touched.

Sensibility to Pain.—Sensibility to pain is tested with a needle or pin. A useful instrument for rapidly detecting analgesia is a dress-pattern perforating wheel with sharp-pointed teeth. The wheel can be rapidly run round a limb in different regions below the wound, asking the patient to say when he ceases to feel a sharp pricking sensation. As in the case of anæsthesia, so in analgesia a zone of diminished sensibility to pain surrounds the area of analgesia. The point of the pin no longer feels a prick, but is felt as a touch or dull blunt point, or sensation only occurs after some delay. There may be a zone of hyperalgesia coinciding in some cases with tactile anæsthesia or hypæsthesia.

Sensibility to Heat and Cold.—Sensibility to heat and cold should next be tested. For this purpose metal tubes or wide test tubes containing sensibly hot water (50° C.) and ice water are employed. The patient should be asked to say "Hot" or "Cold" according to the sensation produced by contact. Around the area of thermoanæsthesia, which usually coincides with the previously charted tactile anæsthesia, there is generally a narrow zone of diminished sensibility and thermal discrimination. Sometimes in this area there is at first only the feeling of contact of the hot tube, but this may subsequently develop into a painful and persistent burning sensation.

Deep Sensibility.—Deep sensibility may be tested in three ways, viz. (1) sensibility to pressure; (2) sense of passive movements and posture; (3) bone sensibility.

(1) The sensibility to pressure may be tested by the head of a pin. In some cases within an area where the cotton wool is not felt pressure with this, or the tip of the finger, is recognised and correctly localised.

(2) The sense of position of joints may be tested by the observer making a number of passive movements of an affected limb, and asking the patient to follow with the sound limb the various movements and postures so affected.

(3) Bone sensibility. To test bone sensibility a large tuning-fork, capable of giving powerful vibrations for more than a minute, is employed. The fork is made to vibrate, and its base is placed upon bony surfaces lying close beneath the skin.

Stereognostic Perception.—Normally a patient should be able to recognise familiar solid objects, such as a key, a knife, or a penny when placed in the hand without seeing them. But from impairment of sensation in some cases of peripheral disease, or owing to defective cortical perception occurring in certain morbid conditions of the brain, the patient may feel the presence of an object yet cannot tell what it is without seeing it.

Subjective Disturbances of Sensibility.—The most important is pain. The patient should be interrogated as to the nature of the pain, whether stabbing, burning, shooting or pricking; whether it is continuous or paroxysmal, localised or general. If localised, the endeavour should be made to ascertain whether the pain corresponds to the areas of distribution of peripheral nerves or posterior roots. When pain is complained of it is important to ascertain whether it occurs spontaneously or is provoked by pressure on a nerve, or a healed scar over a nerve.

Many neurasthenic patients complain of pains and other subjective disturbances of sensibility such as numbness and formication, but these sensory symptoms are also common in organic disease and lesions of the nervous system, and when they occur they should only be regarded as of functional origin, after exclusion of the existence of organic disease by an examination of the superficial and deep reflexes.

PERIPHERAL SENSORY NERVE DISTRIBUTION OF
THE UPPER AND LOWER LIMBS (AFTER BENISTY).

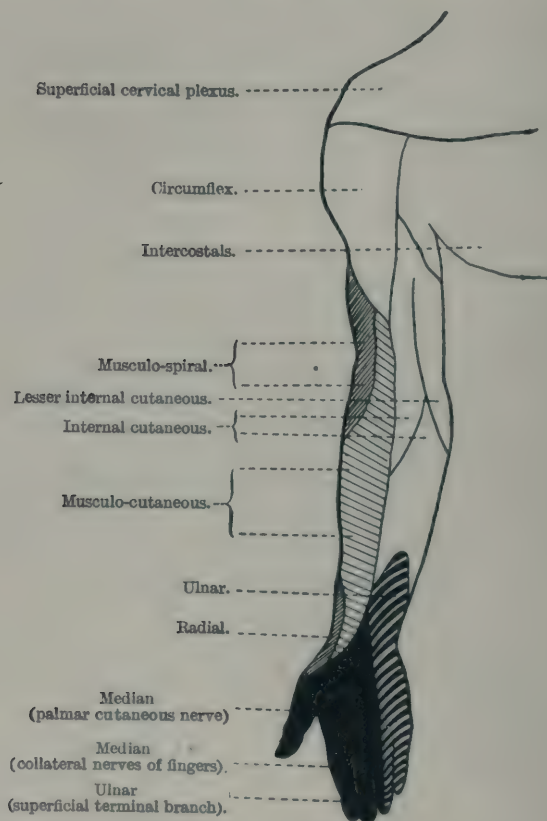


FIG. 1.—Peripheral sensory distribution of the upper extremity (palmar aspect).

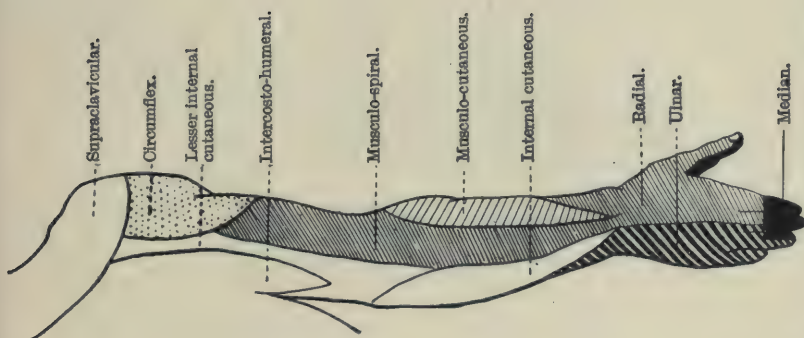


FIG. 2.—Peripheral sensory distribution of the upper extremity (dorsal aspect).

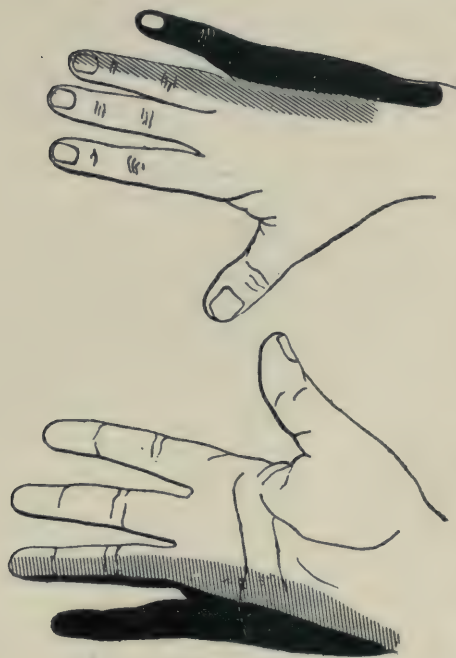


FIG. 3.—Area affected by sensory changes in grave lesions of the ulnar nerve. Black: total anaesthesia. Grey: hypaesthesia to pricking, anaesthesia to heat and cold.

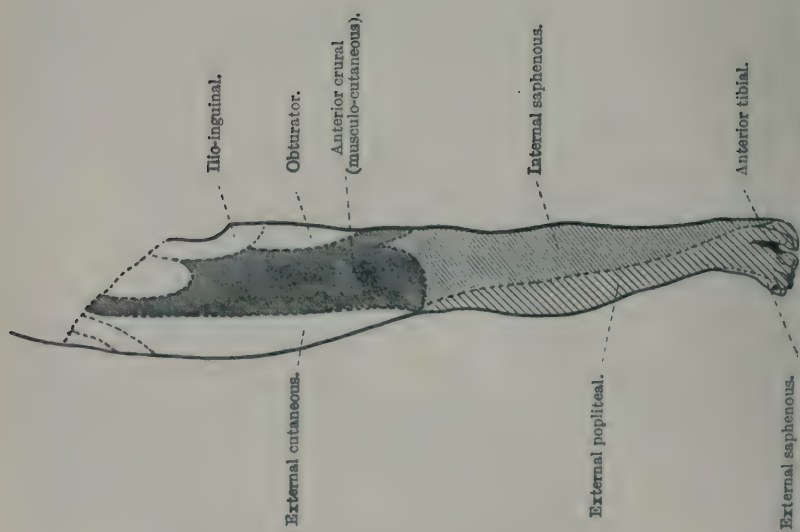


FIG. 4.—Peripheral sensory distribution of the lower extremity (anterior aspect).

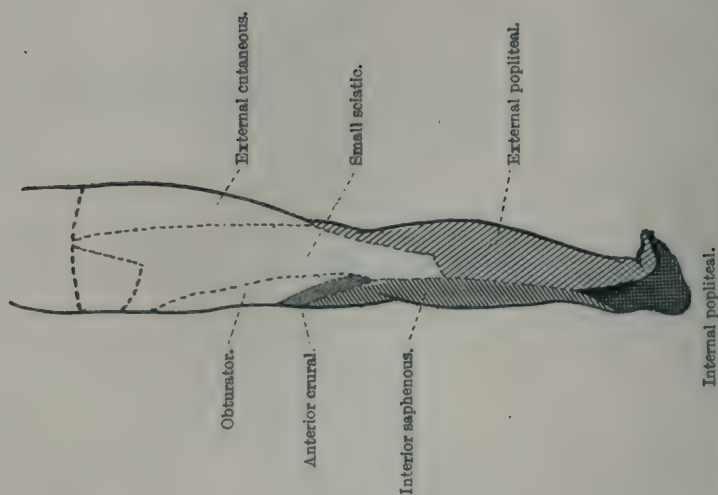


FIG. 5.—Peripheral sensory distribution of the lower extremity (posterior aspect).

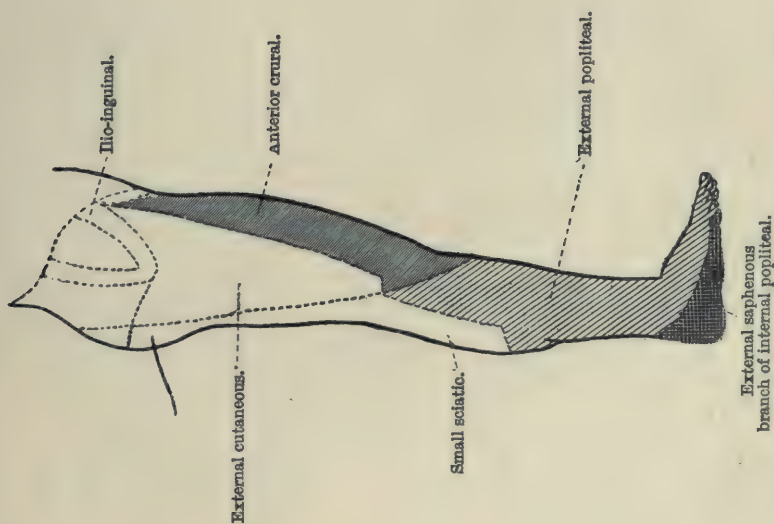


FIG. 6.—Peripheral sensory distribution of the lower extremity (external aspect).

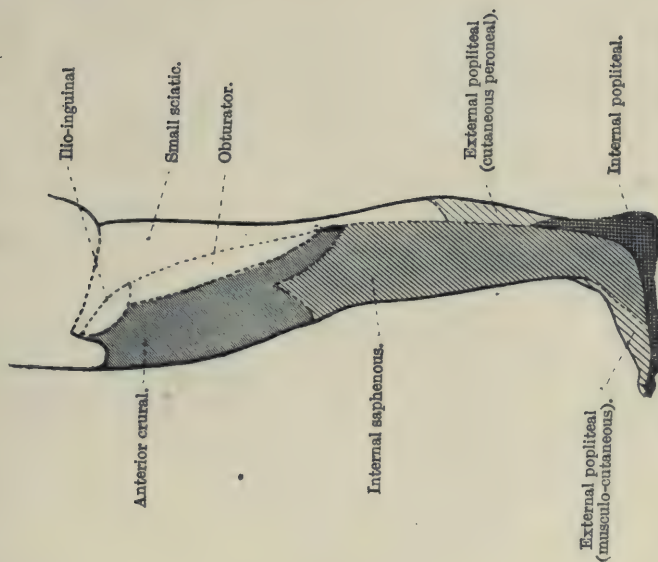


FIG. 7.—Peripheral sensory distribution of the lower extremity (internal aspect).



FIG. 8.—Peripheral sensory distribution of the foot.

THE REFLEXES

Cutaneous Reflexes.—A routine examination of the abdominal reflexes and the cutaneous reflexes of the lower extremity should be made in all cases, as they are of extreme importance in the differential diagnosis of functional and organic disease.

The Plantar Reflex.—Of all the superficial reflexes this is of the greatest practical importance, and therefore it is well to give details how it may be best obtained. The patient should be lying down on a couch or bed, and the limb to be tested is partially flexed at the hip and knee and rotated out a little. The outer side of the sole of the foot is now stroked with the head of a pin from the heel to the toes. If stroking the outer side produces no result, the middle of the sole or its inner side should be stroked. Under normal conditions there is flexion of the toes, but when there is degeneration of the pyramidal tracts a slow extension (dorsal flexion) of the great toe occurs, which may or may not be accompanied by fanning of the other toes. This is known as Babinski's sign.

Oppenheim's sign may be tried if Babinski's sign cannot be obtained. This is an extensor movement of the great toe evoked by strong friction of the muscles on the inner aspect of the tibia.

A visible contraction of the upper and outer aspect of the thigh usually accompanies the toe movements produced by plantar stimulation.

The Cremasteric Reflex.—This reflex is obtained by stroking the inner surface of the thigh from the groin to the knee; retraction of the testicle may be produced.

The Abdominal Reflex.—In young adults, whose abdominal walls are apparently normal, absence of this reflex is important evidence of organic disease of the central nervous system. The patient should be recumbent and the muscles of the abdominal wall quite relaxed. The

abdomen is then stroked with the blunt point of a pin from the margin of the ribs downwards; a reflex contraction should be observed in the superior, median and inferior regions of the abdomen.

There are no important cutaneous reflexes of the upper extremity.

The Deep Reflexes.—Only those will be described which are essential for a clinical examination.

Lower Extremity

The two important reflexes are the knee jerk and the tendo Achillis jerk. There are other less important tendon reflexes which can be obtained by percussion of their respective tendons at the ankle, viz. reflexes of the tibialis anticus, tibialis posticus and peronei.

The Knee Jerk.—The knee is kept in a position of semi-flexion, either by crossing one leg over another, or with the foot resting on the ground. The left hand of the observer should be applied to the front of the thigh so as to be able to feel the slightest contraction of the quadriceps extensor. If it is not obtained the patient is told to look up to the ceiling, and with his hands clasped in front, he is told to pull while the patellar tendon is struck with the percussor.

The Tendo Achillis Jerk.—The patient is told to kneel on a chair with the feet projecting over the edge. He is then told to relax the muscles of the leg. The foot is now lightly held at a right angle by the left hand of the observer, and the bare tendon is struck with the percussor. The advantage of the observer holding the foot is that the slightest reaction can be felt; moreover, it avoids the possibility of a movement of the whole foot being mistaken for a reflex contraction.

Upper Extremity

Tendon Reflexes.—The principal reflex is the triceps. To obtain this reflex the patient is told to let the arm

hang quite loosely by the side of the body; the observer then takes the wrist of the patient and flexes the elbow, asking the patient to keep the muscles relaxed; he then percusses the tendon of the triceps just above its insertion into the olecranon. An extension of the forearm at the elbow is the response.

The Wrist-tap Contraction.—The elbow is semi-flexed; the wrist must be thoroughly relaxed and the hand placed midway between pronation and supination. The wrist is now percussed on the stylo-radial process. Normally this causes a contraction of the flexor of the elbow, viz. the biceps, brachialis anticus and the supinator longus.

ELECTRO-DIAGNOSIS

An electrical examination of the neuro-muscular system may establish one of three conditions :—

- (1) The muscles and nerves react *normally*.
- (2) The reactions may present quantitative changes from the normal.
- (3) The reactions may present qualitative changes.

For diagnostic purposes the three most important forms of electricity are the faradic, interrupted or induced, the galvanic or continuous, and the condenser discharge. As a rule the faradic, interrupted or induced current, is all that is necessary for practical purposes.

To test the contractibility of a muscle the patient is placed in a recumbent position on a couch. The part to be tested is moistened with warm water or salt water. A large well-moistened flat electrode is placed over an indifferent part of the body, such as the upper part of the spine for testing the upper part of the body, and over the lumbar spine for the lower part of the body. The active electrode, well moistened, should be small, $\frac{3}{4}$ in., and this is applied to the various motor points indicated in the figures. These represent positions at which the

maximum effect can be obtained with comparatively weak currents. The strength of the currents should be tried on oneself, as it reassures the patient. The motor points can best be learnt by practising upon oneself. In the case of unilateral neuro-muscular affection, it is best to test the muscles on the sound side and then see whether the reaction is obtainable by placing the electrode on corresponding points on the affected side. If there is no reaction the current can be increased in intensity by gradually sliding the secondary coil up towards the primary. When very strong currents have to be employed to excite a contraction in a diseased muscle, there is a difficulty in observing whether a reaction occurs, due to the current overflowing into surrounding unaffected muscles which contract forcibly and mask the feeble contraction of the affected muscle. It is advisable, therefore, to localise the effects of the faradic excitation by applying two small electrodes directly over the muscle to be tested.

The comparative effects of stimulation of similar motor points on the two sides may show three conditions of the affected side :—

(1) The faradic irritability may be diminished; (2) it may be lost even with the strongest current; (3) if the strength of current necessary to excite a minimum contraction in the muscle of the sound limb causes a more obvious contraction on the affected side, faradic irritability is increased.

The active electrode may be placed on the nerve, provided it is superficially situated, and the resulting contraction noticed.

Should the faradic interrupted current not give a normal reaction the constant current may be employed, and we may find correspondingly decrease, increase, or loss of excitability.

A normal muscle responds briskly to galvanic stimulation. A slow, diffuse and worm-like contraction is

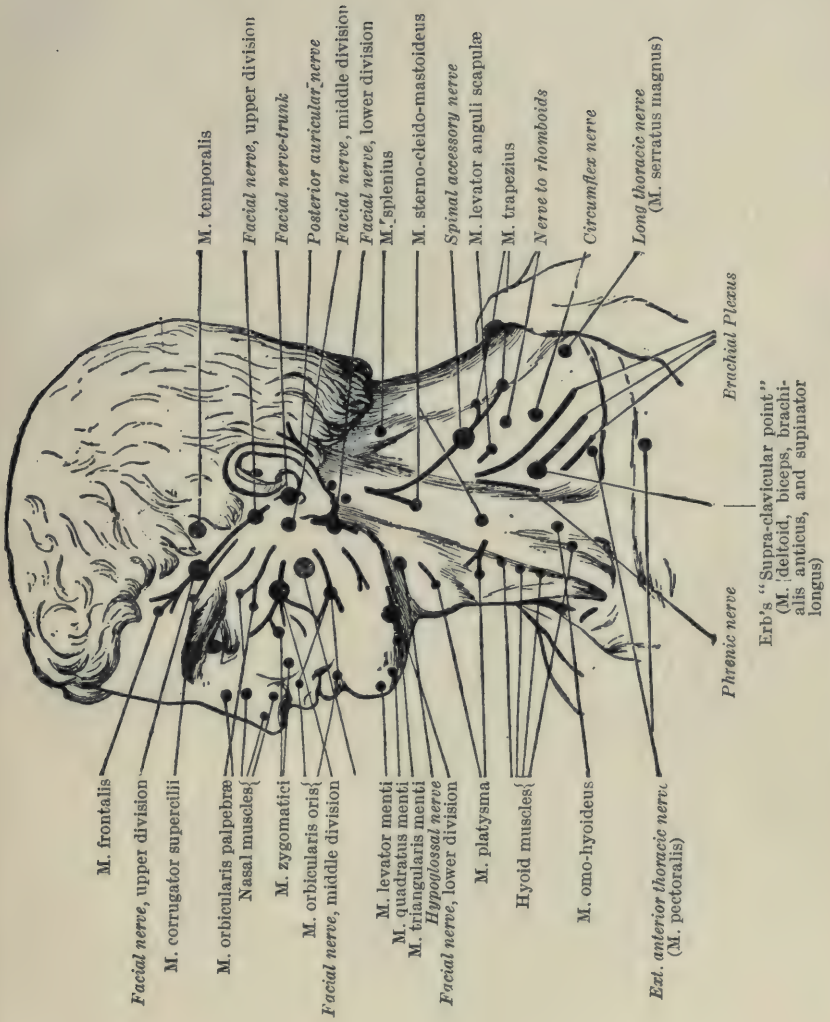


Fig. 9.—Motor Points of Face and Neck. (Erb.)

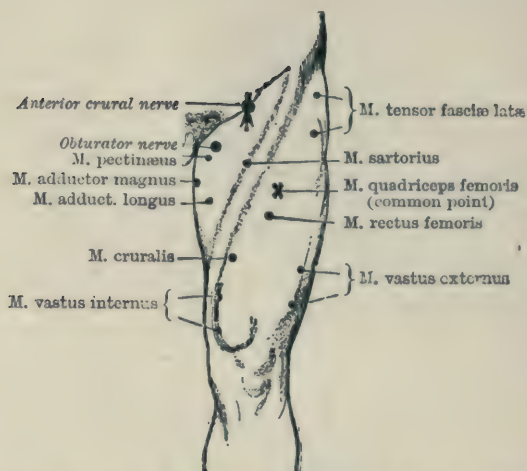


FIG. 10.—Motor Points of Anterior Thigh Muscles. (Erb.)

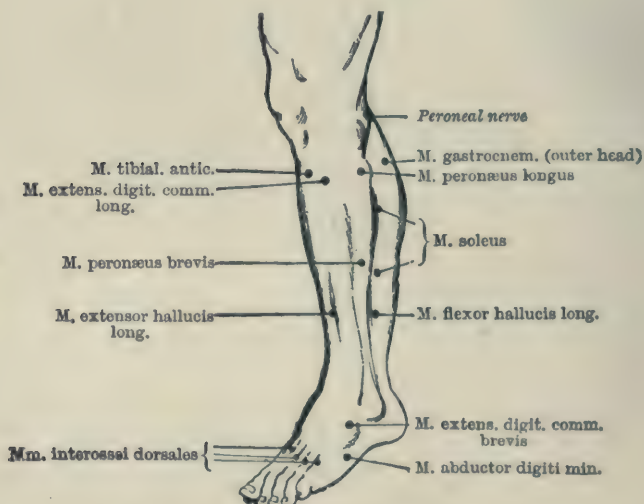


FIG. 11.—Motor Points of Leg. (Erb.)

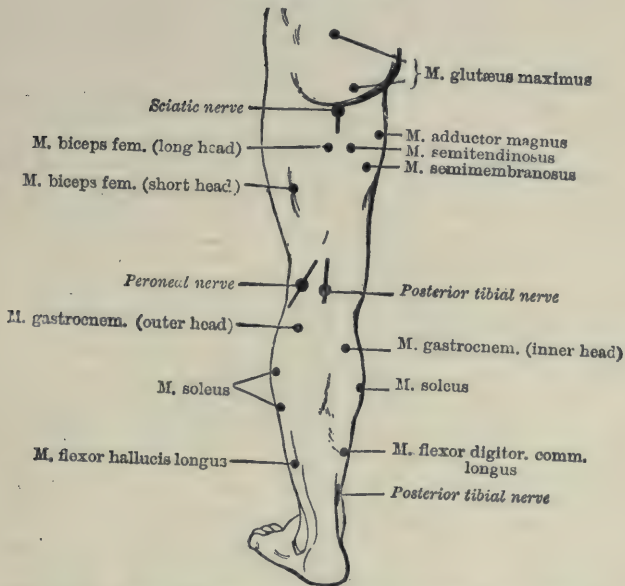


FIG. 12.—Motor Points at back of Thigh and Leg. (Erb.)

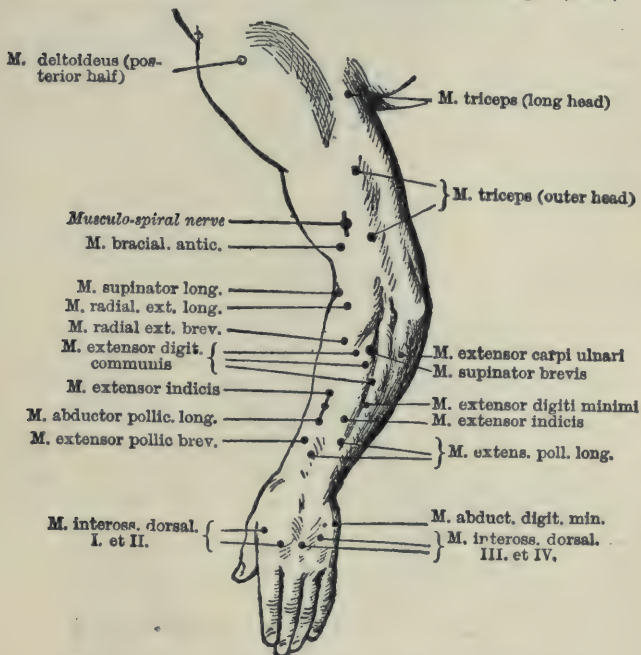


FIG. 13.—Motor Points of Upper Limb. (Erb.)

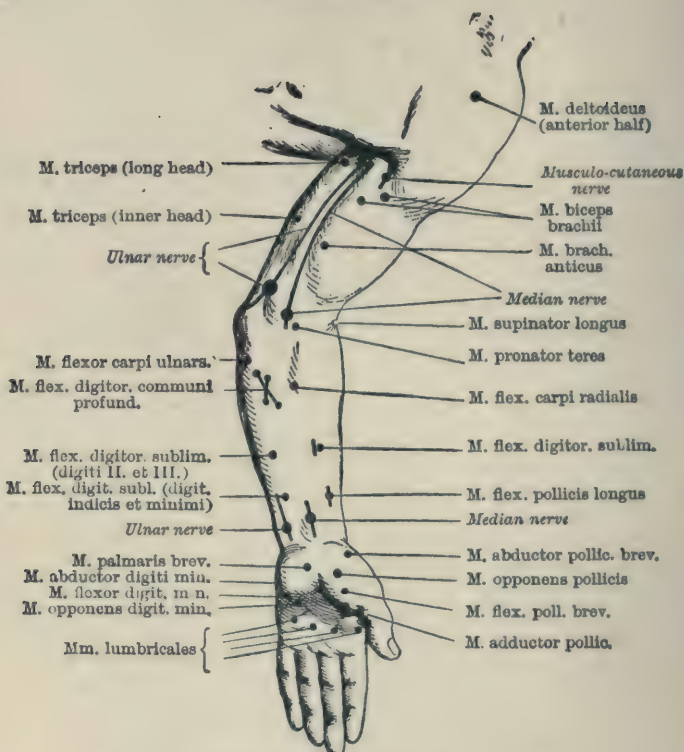


FIG. 14.—Motor Points of Upper Limb. (Erb.)

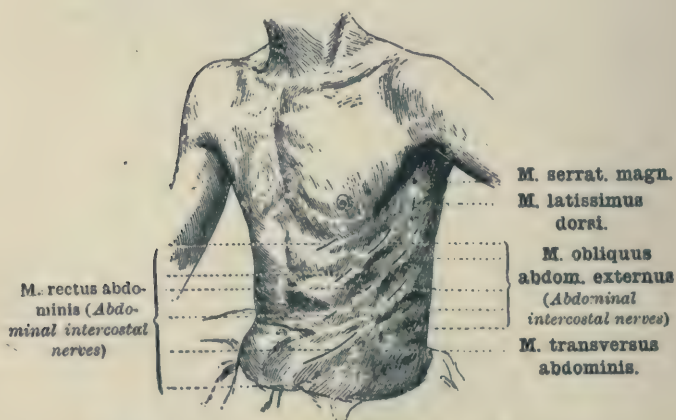


FIG. 15.—Motor Points of Abdominal Wall. (Erb.)

characteristic of degeneration. In fact, a sluggish contraction of a muscle to the galvanic current is a far more reliable indication of degeneration than the much-talked-of anodal closure contraction.

The condenser is now used extensively for testing quantitatively and qualitatively the reaction of muscles.

THE CONDENSER

The use of the condenser discharge is gradually superseding any other method of electrical testing. It affords more accurate information, and the results obtained can be expressed quantitatively. When the muscles are relatively inexcitable it is less painful than other forms of stimulation. The procedure advocated by Doumer, at the International Congress of Barcelona, 1911, should be adopted.

A large indifferent electrode and a stimulating electrode of 2 sq. c.m. are used. The electrodes are moistened with normal saline.

The exciting electrode is placed over the nerve, and the results are compared with those of the sound limb. The current is alternatively reversed, so as to give results for + and - electrodes.

The characteristic of Intensity is obtained by first determining the potential necessary to produce a minimal contraction with a condenser of 10 M.F. (Micro-Farads) = V , and then finding the limen with a condenser of the same capacity but with a resistance of 2000 ohms introduced = V'' .

Characteristic of intensity, I , = $\frac{V'' - V}{2000}$ milliamperes.

To find the characteristic of Quantity, Q , the potential necessary to produce a minimal contraction with a condenser of $\frac{1}{10}$ M.F. is found to = V' .

The characteristic of quantity, Q , = $\frac{V' - V}{100}$ micro-coulombs.

The characteristic of Time is the most important.

Characteristic of time, $T, = \frac{Q}{i}$ in thousandths of a second.

The reaction of degeneration may be complete or partial.

In *complete degeneration* the faradic irritability is abolished, and the galvanic irritability is either increased or abolished. If a contraction occurs it is a sluggish, worm-like response, and the anodic closure contracture, A.C.C., is either equal to or greater than the kathodic closure contraction.

In *partial reaction of degeneration* there is decreased faradic and galvanic irritability of the nerve, and decreased irritability to faradism in the muscle. Galvanic irritability of the muscle may be decreased or increased, and the contraction is sluggish and worm-like.

CLINICAL EXAMINATION OF A NERVOUS CASE

Only sections applicable to the case need be fully noted

PATIENT COMPLAINS OF :—

HISTORY OF PRESENT ILLNESS :—

PAST HISTORY :—

FAMILY HISTORY :—

GENERAL CONDITION :—Nutrition. Build. Physiognomy.

Examination of circulatory, respiratory and urinary systems.

CRANIAL NERVES :—

I. *Smell*.—Test each nostril separately (peppermint, oil of cloves).

II. *Vision*.—Impairments of visual fields. Chart. Colour vision. Fundus oculi. Note errors of refraction.

III. IV. VI. Reaction of pupils to light. Consensual reflex. Reaction to accommodation. Equality. Shape and size of pupils. Movements of eyes. Presence and nature of diplopia. Presence of nystagmus, in what direction.

V. *Motor*.—Deviation of jaw on opening mouth. Contraction temporals on closing jaw. Contraction floor of mouth on swallowing.

Sensory.—Trigeminal area. Taste.

VII. *Contraction* of upper and lower facial muscles, screwing up eyes and showing teeth. If paralysed, whether to both voluntary and emotional movements.

VIII. *Hearing*.—Aerial and bone conduction.

Vestibule.—If giddiness is present, test on rotating chair.

IX. X. XI. Movements of palate, pharynx, vocal cords. Deglutition. Nervous disorders of heart and abdominal viscera.

XII. Movements of tongue.

MUSCULAR SYSTEM :—

A. Upper Extremity.

General.—Wasting. Development. Hypertrophy.

Electrical reaction of affected muscles. Tonus. Spasticity or rigidity.

Movements.—

(1) *Shoulder Joint*.—Adduction, abduction, pronation, retraction, rotation in and out, elevation, circumduction.

(2) *Elbow Joint*.—Flexion, extension.

(3) *Wrist Joint*.—Dorsiflexion, flexion, eversion, inversion, pronation, supination.

(4) *Fingers*.—Flexion, extension, adduction, abduction.

(5) *Thumb*.—Apposition, circumduction, flexion, extension.

B. Lower Extremity.

General.—Wasting. Development. Hypertrophy.

Electrical reaction of affected muscles. Tonus. Spasticity or rigidity.

Movements.—

- (1) *Hip Joint.*—Flexion, extension, abduction, adduction, eversion, inversion.
- (2) *Knee Joint.*—Flexion, extension.
- (3) *Ankle Joint.*—Dorsiflexion, extension, inversion, eversion.
- (4) *Toes.*—Flexion, extension, abduction, adduction.

C. Head and Neck.

Movements.—Flexion, extension, inclination, rotation.

D. Spinal Muscles.

Curvatures of spine. Rigidity.

Movements.—Flexion, extension, rotation, lateral movements.

E. Abdominal Muscles.

Equality of contraction. Lateral or vertical movements of umbilicus.

F. Co-ordination.

Of upper and lower extremities with eyes open and eyes shut. Tremors, coarse or fine. Gait. Rhomberg's symptom.

SENSORY SYSTEM :—

A. Objective Examination.

Note loss of touch sensation (cotton-wool test).

Note loss of pain sensation (pin prick).

Note loss of thermal sensation (hot and cold test tubes).

Make charts of areas affected.

Stereognostic sense—recognition of objects.

Muscle sense—sense of passive movement.

Localisation of touch.

Bone sensation—tuning-fork test.

Hypersensitiveness to pain and pressure.

Loss of bladder, rectal or sexual sensations.

B. Subjective Examination.

Note distribution of pain, referred pain, paræsthesia, formication, numbness.

SPHINCTERS :—

Urinary.—Reflex incontinence. Precipitate or delayed micturition. Overflow incontinence.

Rectal.—Reflex incontinence. Paralysis of sphincters.

REFLEXES :—

A. Deep.

(1) Upper Extremity.—Triceps and supinator jerks.

(2) Lower Extremity.—Knee jerk. Achilles jerk. Note presence of clonus.

(3) Jaw jerk.

B. Superficial.

Abdominal and epigastric.

Plantar reflex—flexor and extensor.

SPEECH :—

If Aphasic—

Does patient understand what he hears ?

Does patient understand what he reads ?

Can he write to dictation ?

Can he write spontaneously ?

Can he name objects ?

Can he understand use of objects ?

Note stammer and dysarthria.

PSYCHICAL :—

Note general intelligence, memory, dreams. Note whether emotional, hypochondriacal, euphoric. If delusions or hallucinations.

TROPHIC DISTURBANCES :—

Trophic ulcers, joint and bone changes. Cutaneous disturbances.

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